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Descriptive Analysis of Fall-Related Injuries Among Older Adults in Ontario

Nicolette Lappan, *The University of Western Ontario*

Supervisor: Zecevic, Aleksandra A., *The University of Western Ontario*

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Abstract

Falls are the leading cause of injury-related hospitalizations among older adults in Canada. The purpose of this study was to describe the characteristics of older adults who experienced fall-related injuries (FRIs) and the types of falls that caused them. We analyzed Ontario-wide secondary data from three databases (NACRS, DAD, RPDB) covering 2010-2014. Older adults (≥ 65 years) who visited emergency departments (ED) with FRIs were selected using ICD-10-CA codes for a fall and injury. Counts, measures of central tendency, and prevalence rates (crude, age- and sex-specific, age-standardized) were calculated. There were 304,610 (63.0% females) ED admissions (3,089 per 100,000 population) and 143,210 (61.2% females) hospitalizations (1,452 per 100,000 population). Rates for most injuries increased with age and were higher for females. Fractures and superficial injuries were the most common. Slips, trips, and stumbles were the most common fall types. Findings suggest that injury prevention should be targeted at females and the oldest old.

Key words: Older adults, falls, injury, fracture, superficial injury, descriptive, population-based, epidemiology.

Summary for Lay Audience

Falls in older adults often cause injuries that require visits to the emergency department or hospitalizations. The purpose of this study was to describe the types of injuries older adults experienced and the types of falls that caused these injuries. The dataset included 304,610 observations over a five-year period from three databases routinely collected by the Ministry of Health and Long-Term Care in Ontario. We calculated rates, which described how many people in every 100,000 experienced an injury, and examined the differences between men and women, and different five-year age groups between 65-69 and 90+ years of age. Results show that 3,089/100,000 older adults experienced an injury due to a fall that required a visit to the emergency department, and 1,452/100,000 were hospitalized. Females were injured more than males (63.0%). Injuries were more common in older age groups compared to younger groups. For example, in the group of 65-69 year-olds, 71/100,000 people had a hip fracture from a fall, while in the group of people 90+ years of age and older 1,184/100,000 had this same injury. Fractures (39.9%) and superficial injuries (23.3%) were the most common injury types. Slips, trips, and stumbles were the most common fall types. Prevention of injuries caused by falls need to be directed at females and those aged 80 years and older.

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[1] Italicized portions of text are a required wording provided by IC/ES and obligatory for inclusion in studies using IC/ES data.

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List of Operational Definitions

Acquired Brain Injury: an umbrella term which covers traumatic and non-traumatic brain injury and may refer to a range of impairments of physical, neurocognitive, or psychological function (Teasell et al., 2007).

Age-Standardized Rate: rate that is mathematically weighted by age groups to match a standard population, thus minimizing the effects of underlying age differences in a population structure so comparison to other populations is more accurate (Statistics Canada, 2017b).

Age-Specific Rate: an expression of frequency of a particular event (e.g. injury) for a particular age group (e.g. individuals 65-69 years of age) where the numerator is the number of cases in a specified age group and the denominator is the number of individuals in that age group in a population, then multiplied by 100,000 (CDC, n.d.).

Fall: "an unexpected event in which the participants come to rest on the ground, floor, or lower level" (Lamb et al., 2005), Jørstad-Stein, Hauer, Becker, & Prevention of Falls Network Europe and Outcomes Consensus). This event must be classified with ICD-10 codes W00-W19.

Fall-Related Injury (FRI): "Fractures, dislocations, head injuries resulting in loss of consciousness, and other injuries resulting in medical care" (Bergland & Wyller, 2004, p. 310), as well as any other injury diagnosis that was caused by a fall and resulted in a visit to ED, or death after admission to ED. In this study, an FRI was defined by two ICD-10-CA codes: (1) a fall code W00-W19; (2) and an injury code S00-S99 or T00-T14.

Index Event: the event which resulted in subsequent diagnosis of an FRI; that is, the fall resulting in serious injury which required medical attention.

Index Date: the date when the first health care records for a patient's FRI are recorded (S. Li, personal communication, November 15, 2019).

Older Adult: a person 65 years of age or older.

R: a system for statistical computation and graphics, which provides a programming language and high-level graphics (R Core Team, 2000).

Registration Date: the date when a patient is registered in the emergency department (S. Li, personal communication, November 15, 2019).

Superficial Injury: abrasion, blister (nonthermal), contusion (including bruise and haematoma), injury from superficial foreign body (splinter) without major open wound, insect bite (Canadian Institute for Health Information, 2015).

Traumatic Brain Injury: "an alteration in brain function, or other evidence of brain pathology, caused by an external force" (Menon et al., p. 1638).

List of Abbreviations

CIHI	= Canadian Institute for Health Information
CINAHL	= Cumulative Index to Nursing and Allied Health Literature
CSV	= Comma-Separated Values File
DAD	= Discharge Abstract Database
ED	= Emergency Department
ICD-8	= International Classification of Diseases, Eighth Revision
ICD-9	= International Classification of Diseases, Ninth Revision
ICD-9-CM	= International Classification of Diseases, Ninth Revision, Clinical Modification
ICD-10	= International Statistical Classification of Disease and Related Health Problems 10th Edition
ICD-10-AM	= International Classification of Diseases, 10th Revision, Australian Modification.
ICD-10-CA	= International Statistical Classification of Disease and Related Health Problems 10th Edition, with Canadian Enhancements
ICD-11	= International Statistical Classification of Diseases and Related Health Problems, 11th Revision
IC/ES	In 2018, the institute formerly known as the Institute for Clinical Evaluative Sciences formally adopted the initialism IC/ES as its official name. This change acknowledges the growth and evolution of the organization's research since its inception in 1992, while retaining the familiarity of the former acronym within the scientific community and beyond.
IKN	= IC/ES Key Number
NACRS	= National Ambulatory Care Reporting System
PHAC	= Public Health Agency of Canada
RNAO	= Registered Nurses Association of Ontario
RPDB	= Registered Persons Database
FRI	= Fall-Related Injury
WHO	= World Health Organization

1. Introduction and Literature Review

This thesis presents a descriptive population-based study that examines fall-related injuries (FRIs) in older adults, people who are 65 years or older. More specifically, the FRIs include only events that resulted in an admission to an Ontario emergency department (ED). The first section of this thesis is an introduction to population aging in Canada and globally. This introduction provides context to understand the impact of falls and the injuries they cause at a population level. The research on falls and FRI is vast, therefore a literature review included here focused on descriptive population-based studies on FRIs only. The second chapter outlines research methods and the third describes findings from this original descriptive study. The final chapters, discussion and conclusions, tie in findings from the previous literature and provide guidance for next steps.

1.1 Population Aging

To understand why FRIs are a problem in older adults, it is first important to recognize the magnitude of population aging. Globally, the number of older adults continues to rise with rates varying by country and region. In 2015, nearly 9% of the global population were older adults and this is estimated to reach 12% by 2030 (He et al., 2016), and 20% (i.e. 2 billion people) by the year 2050 (World Health Organization, 2017). Over the last several decades, life expectancy has increased which has resulted in an increase in the number of older adults. In 2016, the global life expectancy was 72 years, and 83 years in Canada (World Health Organization, 2018). Population aging is present in Canada; there are currently more Canadian older adults than youth aged 15 years or younger (Statistics Canada, 2017a). Population aging is also seen at the provincial level. In Ontario, older adults compose the fastest growing age group in the province. As of 2016, 16% of Ontario's population were older adults (i.e., 2.3 million people), and that number is expected to double by the year 2041, meaning one-quarter of Ontarians will be older adults (Government of Ontario Ministry for Seniors and Accessibility, 2017).

1.2 Falls and Fall-Related Injuries

In this thesis, a *fall* is defined as "an unexpected event in which the participants come to rest on the ground, floor, or lower level" (Lamb et al., 2005, p. 1619). As the population

ages, it can be expected that there will be a greater number of falls and FRIs that will occur in Canada. Since early falls research in the 1980s, the proportion of older adults who experienced falls has remained consistent. Two classic studies on falls in later life found that approximately one-third of community dwelling older adults falls at least once in a one-year period (Campbell et al., 1981; Tinetti et al., 1988). Four decades later, fall researchers report similar percentages. For example, in the United States, Bergen et al. (2016) reported that 28.7% of older adults fell in a one-year period and the Utah Department of Health (2016) reported one-third.

In 1995, King and Tinetti reported that most falls among older adults do not result in major adverse consequences, and minor injuries occur in 30-55% of cases. However, in some instances, falls can result in serious injuries, or even death. Studies from the first decade of the 21st century found that approximately 30-40% of older adults who fell reported an injury, and as many as 6% of falls caused serious injuries such as fractures, concussions and head injuries requiring hospitalization (Nachreiner et al., 2007; Stevens et al., 2008). A Canadian report summarized that almost half of older adults who fall have a minor injury and 5-25% have more consequential injuries like fractures or sprains (Scott et al., 2004).

Bergland and Wyller (2004) defined serious FRIs as “fractures, dislocations, head injuries resulting in loss of consciousness, and other injuries resulting in medical care” (p. 310). In this study, the operational definition of an FRI included Bergland and Wyller’s definition (2004) and added any other injury diagnosis that was caused by a fall and resulted in a visit to ED, or death after admission to ED. FRIs among older adults are particularly concerning as they may be consequential for not only the faller, but also the family caregivers and healthcare system. The FRIs can require an older adult to make major lifestyle alterations. Functional abilities may diminish, resulting in a reduction of independence and self-efficacy, and the need for a higher level of care. For example, Schiller and colleagues (2007) reported that one-third of non-institutionalized older adults who experienced an FRI leading to an ED visit required assistance with activities of daily living, while Bergen et al. (2016) reported that 37.5% of non-institutionalized older adults who reported at least one fall in a 12-month period required medical treatment or restricted their activity for at least one day. However, rates of falls and FRIs vary by sex

and age group, for example, females typically have higher rates. Prudham and Evans (1981) reported a rate of 3,440 per 100,000 females and 1,900 per 100,000 males in the United Kingdom had a fall, and in Canada, Do et al. (2015) found that 7,240 per 100,000 females and 4,270 per 100,000 males had an FRI in 2013.

A 2012 article by Zecevic et al., (2012) examined the average cost and length of stay of patients who experienced serious FRIs while in hospital. Hospital costs were $30,696 greater for patients who experienced an in-hospital serious FRI than inpatients who did not, while an average length of stay for people with an FRI increased from 11 to 45 days (Zecevic et al., 2012). A Canadian report (SMARTRISK, 2009) found that in 2004, the financial burden of falls in Canadian older adults was over $2 billion CAD, and the per-person cost was 3.7 times higher among older adults compared to adults aged 25 to 64. In Ontario in 2004, the direct healthcare costs due to 'falls from the same level' was $458 million, and the total cost was $610 million (SMARTRISK, 2009).

There are certain injury types that are frequently considered in the research of falls consequences in older adults. For example, fall-related fractures are common in older age and account for 37% of FRIs in older Canadians (Do et al., 2015). Older adults often fear hip fractures as they are associated with high morbidity and mortality and they become more common with advancing age (Jørgensen et al., 2014). Notably, Høidrup and colleagues (2003) reported the rate of hip fractures increased from 22.5 per 1,000 person years in females aged 45-49 to 170.8 in females aged 85 and older. In males, this increase was not as sizeable, from 22.5 to 112.8 per 1,000 person years in the same age groups (Høidrup et al., 2003). These are alarming figures for the healthcare system that will care for the needs of injured oldest old.

Head injuries are also common FRIs in later life. An acquired brain injury is an umbrella term which covers traumatic and non-traumatic brain injury and may refer to a range of impairments of physical, neurocognitive, or psychological function (Teasell et al., 2007). Traumatic brain injury (TBI) is defined as "an alteration in brain function, or other evidence of brain pathology, caused by an external force" (Menon et al., p. 1638). Falls are responsible for approximately 50-60% of TBIs among adults (Faul et al., 2010; Thompson et al., 2006), whereas motor vehicle crashes account for about 8% (Faul et al., 2010). The likelihood of experiencing a fall-related TBI increases with advancing age

(Chan et al., 2013). Faul et al. (2010) reported that in the United States adults aged 75 and older have the highest rates of TBI-related hospitalizations and mortality (339 per 100,000 population) compared to all other ages (57 per 100,0000 population). Although fractures and head injuries are the most common, they are not responsible for all FRIs in older adults; thus, it is essential to explore and report all injury types experienced by older adults.

This brief introduction has expressed the importance of addressing falls and FRIs in older adults as this population continues to grow, due to an increase in life expectancy and advances in healthcare. However, with the growth comes a likely influx of older adults sustaining FRIs, and therefore an additional burden on the healthcare system. Better injury prevention strategies are needed to minimize suffering and reduce the number of older adults requiring access to higher levels of care. An understanding of fallers who were injured, types of injuries and types of causes will inform who to target for fall prevention strategies. Most of the existing literature focuses on falls in general (e.g., with or without an accompanying injury), but here the focus is on injuries. The literature review that follows sought to answer four questions at the population level: 1) What is known about people who experience FRIs?, 2) What types of FRIs are occurring among older adults?, 3) How did rates of FRIs change over time?, and 4) What types of falls are causing various injury types? The goal is to map what is known, identify a gap in the current knowledge and design a project that will fill the gap and help guide future injury prevention programs.

1.3 Literature Review

A narrative literature review that follows provides a description of what is known about FRIs from population-based descriptive studies on FRIs published in peer-reviewed journals and Canadian population-based FRI reports. Table 1-1 presents a summary of the datasets used in studies and reports examined in this literature review.

Table 1-1

Summary of Datasets used in Studies Included in the Literature Review

Year	Author	Country	Total N	Time frame	Age groups	Data source	Observation type	Injury type	Cause
1999	Stevens et al.	US	Death: 8,474 Hip fracture: 339,692	Deaths: 1987-1996 Hip fracture: 1988-1996	65-74 75-84 85+	National	Hospital Mortality	Hip fractures Death	Fall only (deaths) All causes (hip fractures)
2002	Soubhi et al.	CA	Death: 3,183 Hospital: 100,513	1987-1998 [n]	65-69 70-74 75-79 80-84 85+	Provincewide	Hospital Mortality	Death All injuries	All causes Falls only
2002	Stevens & Dellinger	US	All cause: 137,618 Falls: 69,806	1990-1998	65+	National	Mortality	Death	Fall, MVA
2003	Thomson, et al.	NZ	6,059	1992-2001[o]	65-74 75-84 85+	National	Hospital	Dental and maxillofacial injuries	All causes
2004	Scott et al.	CA	N/A	1992-2001 [p]	65-74 75-84 85+	Provincewide	Hospital Mortality ED	Death All injuries	Fall only
2005	Carey & Laffoy	IE	18,546 [b]	1994-2002	65-69 70-74 75-79 80-84 85+	National	Hospital	All injuries	Fall only
2005	Coronado et al.	US	All causes: 17,657 Falls: 11,851	1999	65-74 75-84 85+	Statewide	Hospital	TBI	All causes
2005	Kannus, Niemi, et al.	FI	N/A[a]	1970-2002	80-84 85-89 90+	National	Hospital	All injuries	Fall only
2005	Mahoney et al.	US	ED: 24,173 Hospital: 16,173 Mortality: 658	1995-2003	65-74 75-84 85+	Statewide & national	ED Hospital Mortality	Fatal and non-fatal fall injuries	Fall only

Year	Author	Country	Total N	Time frame	Age groups	Data source	Observation type	Injury type	Cause
2005	PHAC	CA	Self-report: 180,353 Hospital: N/A Death: 7,319	2002-2003 [q] 1998-2003 1997-2002	65-69 70-74 75-79 80+ 65-74 75-84 85+	National	Self-report Any treatment Hospital	All injuries Death	Fall only
2007	Kannus et al.	FI	N/A [c]	1970-2004	80-84 85-89 90+	National	Hospital	Severe head injuries	All causes
2007	Fletcher et al.	US	All causes: 9,767 Falls: 6,846	1992-2003	65-74 75-84 85+	Statewide	Hospital	TBI	All causes
2008	Orces	US	6,767	1981-1998	65-69 70-74 75-79 80-84 85+	National	Mortality	Death	Fall only
2009	Kannus et al.	FI	N/A [d]	1970-2007	80-84 85-89 90+	National	Hospital	Proximal humerus fractures	Fall only
2009	Stevens et al.	US	47,312 [e]	2001-2006	65-74 75-84 85+	National	ED	Nonfatal unintentional injuries	Falls with walkers or canes
2010	Hartholt et al.	NL	N/A [f]	1981-2008	65-69 70-74 75-79 80-84 85-89 90-94 95+	National	Hospital	All injuries	Fall only
2010	Scott et al.	CA	53,545	2008-2009 [r]	65-74 75-84 85+	National	Hospital	All injuries	Fall only
2011	CIHI	CA	Older adults: 2,933	2008-2009 [r]	All ages 65+	National Included 107 hospitals from eight provinces	Hospital	All injuries Death	All causes Fall Only

Year	Author	Country	Total N	Time frame	Age groups	Data source	Observation type	Injury type	Cause
2011	Hartholt, Stevens, et al.	US	N/A [g]	2001-2008	65-69 70-74 75-79 80-84 85+	National	Hospital	All injuries	Fall only
2011	Hartholt, Van Lieshout, et al.	NL	32,133	1986-2008	65-69 70-74 75-79 80-84 85, 89 90+	National	Hospital	TBI	Fall only
2011	Watson & Mitchell	AU	189,307	1998-2009 [s]	65+	Statewide	Hospital	All injuries	Fall only
2012	Harvey & Close	AU	12,564	1998-2011 [t]	65-69 70-74 75-79 80-84 85+	Statewide	Hospital	TBI	All causes
2012	Korhonen et al.	FI	N/A [h]	1970-2009	80-84 85-89 90+	National	Hospital	All injuries	Fall only
2012	Oudshoorn et al.	NL	All causes: 31,650 Falls: 26,126	1986-2008	65-69 70-74 74-79 80-84 85+	National	ED & hospital	Vertebral fractures	All causes
2012	Alamgir et al.	US	79,386	2003-2007	65-69 70-74 75-79 80-84 85+	National	Mortality	Death	Fall only
2013	Cassell & Clapperton	AU	136,915	1998-2009 [s]	65-69 70-74 74-79 80-84 85+	Statewide	Hospital	All injuries	Fall only

Year	Author	Country	Total N	Time frame	Age groups	Data source	Observation type	Injury type	Cause
2013	Orces	US	5.04 million [i]	2001-2008	65-69 70-74 75-79 80-84 85+	National	ED	Fractures	Fall only
2014	PHAC	CA	Self-report: 256,011 Hospital: N/A Death: 12,631	2003-2010 [u] 2006-2011 [v] 2010-2011 [u] 2003-2008	65-69 70-74 75-79 80-84 85-89 90+	National	Self-report, any treatment, hospital	All injuries Death	Fall only
2015	Brazinova et al.	AT	All causes: 16,204 Falls: 7,768	1980-2012	65-69 70-74 75-79 80-84 85-89 90+	National	Mortality	Fatal TBI	All causes
2015	Parachute	CA	ED: 15,079 Hospital: 2,900	2014-2015 [w]	65-69 70-74 75-79 80-84 85-89 90+	Provincewide	ED Hospital	Head injuries	Fall only
2016	DeGrauw et al.	US	N/A	2006-2011	65-69 70-74 75-79 80-84 85-89 90-94 95-99 100+	National	ED	All injuries	All causes
2016	Nilson et al.	SE	N/A [j]	2001-2010	65-79 80+	National	Hospital	All injuries	Fall only
2016	Parachute	CA	N/A	2011-2015	All ages 65-74 75+	Provincewide	ED Hospital	All injuries	Falls on stairs
2018	Kannus, Niemi, et al.	FI	N/A [k]	1970-2014	80-84 85-89 90+	National	Hospital	Wounds and lacerations	Fall only

Year	Author	Country	Total N	Time frame	Age groups	Data source	Observation type	Injury type	Cause
2018	Kannus, Parkkari, et al.	FI	N/A [l]	1970-2016	80-84 85-89 90+	National	Hospital	All injuries	Fall only
2018	Parachute	CA	ED: 257,738 Hospital: 61,665	2014-2016 [x]	All ages 65-69 70-74 75-79 80+	Provincewide	ED Hospital	All injuries	All causes Fall only
2019	Olij et al.	NL	N/A [m]	1997-2016	65-74 75-84 85+	National	ED Hospital Mortality	All injuries, death	Fall only

Note. CIHI = Canadian Institute for Health Information. ED = Emergency Department. TBI = Traumatic Brain Injury. MVA = Motor Vehicle Accident. AT = Austria. AU = Australia. CA = Canada. FI = Finland. IE = Ireland. NL = Netherlands. NZ = New Zealand. SE = Sweden. US = United States of America. [a] Total N not reported; annual N ranged from 1,139 to 11,835. [b] Single year (2002, n=2,309) analyzed in more detail. [c] Total N not reported; annual N ranged from 85 to 1,095. [d] Total N not reported; annual N ranged from 32 to 478. [e] National estimate derived from a sample of 3,932 cases. [f] Total N not reported; annual N ranged from 14,398 to 34,091. [g] Total N not reported; annual N ranged from 373,128 to 559,355. [h] Total N not reported; annual N ranged from 927 to 10,333. [i] National estimate derived from a sample of 70,199 cases. [j] Total N not reported; annual N ranged from 37,772 to 40,731. [k] Total N not reported; annual N ranged from 52 to 1,393. [l] Total N not reported; annual N ranged from 1,139 to 16,067. [m] Total N not reported; annual N ranged from 64,810 to 96,186. [n] Fiscal years 1987 to 1998. [o] Fiscal years 1992/1993 to 2000/2001. [p] Fiscal years 1992/1993 to 2000/2001. [q] Fiscal years 2002/2003 and 1998/1999 to 2002/2003. [r] Fiscal year 2008/2009. [s] Fiscal year 1998/1999 to 2008/2009. [t] July 1998 to June 2011. [t] Fiscal years 2006/2007 to 2010/2011, 2010/2011. [u] 2003, 2005, and fiscal year 2009/2010. [v] Fiscal years 2006/2007 to 2010/2011. [w] Fiscal year 2014/2015. [x] Fiscal years 2014/2015 and 2015/2016.

This section starts with the presentation of findings about FRI ED admissions, followed by hospitalizations, and mortality. Next, types and locations of the falls that caused injuries were described in detail, separated for hospital, ED, and mortality. Varying patterns and similarities of FRIs are presented, followed by recommendations for future research and FRI prevention.

FRI research was most frequently reported from the United States, Finland, the Netherlands, and Australia. Most Finnish studies came from the Urho Kaleva Kekkonen (UKK) Institute – Centre for Health Promotion Research in Tampere, under the leadership of Dr. Kannus. Erasmus University in Rotterdam, Netherlands, led by Dr. Hartholt and the National Center for Injury Prevention and Control, Center for Disease Control and Prevention in the United States, led by Dr. Stevens also conducted multiple FRI studies. All reviewed studies used population-based data from nationwide or state and provincewide datasets, though hospital-level data was more common than the ED (Table 1-1).

1.3.1 Emergency Department Level of Care

Overall, falls were the leading cause of ED visits for injuries in older adults (Parachute, 2018). Between 2014 and 2016 in Ontario, the age-specific rate of ED visits for FRIs increased with each five-year age group, from 3,101 per 100,000 (65-69 years) to 11,497 per 100,000 (80+ years; Parachute, 2018). Olij et al. (2019) also reported an age-related increase in the Netherlands; from 202 per 100,000 (65-74 years) to 915 per 100,000 (85+ years). Rates of FRIs at the ED were consistently higher among females than males, in all age groups. In the United States, Mahoney et al. (2005) found that the rate of all FRIs was 4,027 per 100,000 females and 2,546 per 100,000 males.

1.3.1.1 Injury Types and Body Locations

The most common injury types and body locations varied by age groups and sex of patients. Orces (2013) identified that the lower trunk (i.e., lumbar spine, pelvis, hip) was the most common body region to sustain fractures in both sexes, and the age-standardized rate among females was more than double that of males. Orces (2013) also found that females predominantly experienced fractures of the wrist followed by upper trunk (i. e., thoracic spine, ribs, sternum). According to Olij et al. (2019), fractures were the most common injury type in the ED, but rate decreased between 1997 and 2016, as did rates

for wounds, luxations/distortions, and superficial injuries, while skull and brain injuries increased with time. The authors explained the decrease in rate of fractures by prevention and treatment of osteoporosis and fall prevention interventions while the rise in head injuries was explained by the greater use of computerized tomography imaging (Olij et al., 2019). Stevens et al. (2009) found that fractures were the most common injury type seen with falls involving walkers and canes, followed by contusions or abrasions. Comparisons between studies should be made with caution as studies examined different injury types and causes and used a variety of classification systems (Table 1-2 and Table 1-3).

Table 1-2

Types and Body Locations of Injuries in Emergency Department Level Literature, Reported in Rates per 100,000

Injury type and body location	DeGrauw et al., 2016	Mahoney et al., 2005		Olij et al., 2019 [a]	Orces, 2013		Parachute, 2015		Parachute, 2018	Stevens et al., 2009 [i]		
	Total	Female	Male	Total	Female	Male	Female	Male	Total	Total	Female	Male
All FRIs	5,057- 5,341 [b]	4,027	2,546	3,200-4,550 [c]					65-69: 3,101 70-74: 3,897 75-79: 5,420 80+: 11,498			
Fracture				1,810-2,560 [c]						49	67	25
Lower trunk					827	383						
Wrist					237	58						
Upper trunk					178	161						
Upper arm					173	54						
Lower arm					122	34						
Shoulder					116	55						
Upper leg					103	41						
Ankle					91	39						
Face					77	46						
Lower leg					66	32						
Knee					52	19						
Foot					44	15						
Elbow					43	19						
Contusion or abrasion										39	52	20
Laceration										18	22	13
Sprain or strain										9	12	4
Internal injury										8	10	6
Skull/brain injury				100-370 [b]			789	601	65-69: 732 70-74: 1,053 75-79: 1,622 80+: 3,733			
Superficial injury				420-1,020 [c]								
Wound				160-400 [c]								
Luxation/distortion				290-170 [c]								
Other/unknown				110-280 [b]						7	9	4

Note. Lower trunk = lumbar spine, pelvis, hip. Upper trunk = thoracic spine, ribs, sternum. FRI = Fall-Related Injury. F = Female. M = Male. [a] Rates recalculated from per 10,000 to per 100,000. [b] Significant increase with time. [c] Significant decrease with time. [d] Non-significant change with time. [e] Patients 80+ years only. [f] Increased until 1990s, then decrease until 2016. [g] Females only. [h] Rates recalculated from per 1,000 to per 100,000. [i] Included only falls involving walkers and canes.

Table 1-3

Injury and Fall Type Classification Coding Systems for Injury Types and Causes Used in Emergency Department Level Studies

Author	Injury causes	Coding system
DeGrauw et al., 2016	All causes	ICD-9-CM
Mahoney et al., 2005	Falls	ICD-9 ICD-10
Olij et al., 2019	Falls	ICD-10
Orces, 2013	Falls	Unknown
Oudshoorn et al., 2012	Low energetic falls	ICD-10
Parachute, 2015	Falls	ICD-10
Parachute, 2016	Falls on stairs	ICD-10-CA
Parachute, 2018	All cause	ICD-10
Stevens et al., 2009	Falls with walkers and canes	ICD-9-CM

Note. ICD-9 = International Classification of Diseases, Ninth Revision. ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification. ICD-10 = International Classification of Diseases, 10th Revision. ICD-10-AM = International Classification of Diseases, 10th Revision, Australian Modification. ICD-10-CA = International Classification of Diseases, 10th Revision, with Canadian Enhancements.

The Parachute (2018) Ontario Injury Data Report (April 2014 to March 2016) found that the head was the most commonly injured body location and rates increased with age from 732 per 100,000 (65-69 years) to 3,733 per 100,000 (80+ years). Hip and thigh injuries were the second most common and also increased with age from 214 per 100,000 in individuals 65-69 years of age to 2,077 per 100,000 those 80 and older (Parachute, 2018). The most common fall-related head injuries in the ED in Ontario were haemorrhages (42%), concussions (22%), and other intracranial injuries (18%). Additionally, Parachute (2015) also reported that rates of ED admissions for all head injuries were higher for females (789 per 100,000) than males (601 per 100,000).

1.3.1.2 Time Trends in Emergency Department Admissions

Time trends of ED admissions for FRIs were inconsistent. In the United States, ED admission rates increased over time (Table 1-2) and could be explained by people living longer and with more chronic conditions than in earlier years (DeGrauw al., 2016). Conversely, Olij and colleagues (2019) reported a significant decrease in the rate of FRIs in all age groups in the Netherlands (65-74 years, 75-84 years, 85+ years), from 4,550 (1997) to 3,200 per 100,000 (2016) overall. Olij et al. also found a shift in the pattern of injury types; an increase in skull and brain injuries and a decrease in fractures. The authors speculated that an overall healthier and more active population of older adults influenced this decrease (Olij et al., 2019). It appears that reported increases in FRI ED admissions could not be explained by a single cause.

1.3.2 Hospital Level of Care

Research that examined patients who were admitted to the hospital for treatment of an FRI was more common than research at the ED level. Fall and injury type coding classification systems used in hospital focused studies varied and are described in Table 1-4. Falls were responsible for 7.3% of all hospitalizations in older adults in 2008/2009 in Canada (Scott et al., 2010). During this time, the age-standardized rate of hospitalizations was 15.5 per 1,000 (1,549 per 100,000 [2]) in all of Canada, and 1,230 per 100,000 in Ontario (Scott et al., 2010). Overall, rates of FRI hospitalizations increased with age in both sexes and were higher in females than males in all age groups (Table 1-5; Carey & Laffoy, 2002; Hartholt et al., 2010; Hartholt, Stevens, et al., 2011; Kannus, Niemi, et al., 2005; Kannus, Parkkari, et al., 2018; Korhonen et al., 2012; Nilson et al., 2016; Parachute, 2018; Public Health Agency of Canada [PHAC], 2014; Scott et al., 2010; Soubhi et al., 2002). Overall, age-standardized rates of all FRI hospitalizations increased consistently with time. Hartholt, Stevens et al. (2011) and Watson and Mitchell (2013) both reported significant increases of FRIs in all age groups and both sexes in the Netherlands and Australia (Table 1-6). Kannus, Niemi, et al. (2005) also reported an increase in rates among Finns 80+ years in both sexes.

[2] Rates from Scott et al. (2010) were originally calculated per 1,000 population, however, for the purpose of comparison they were recalculated per 100,000 in this review.

Table 1-4

Injury and Fall Type Classification Coding Systems for Injury Types and Causes Used in Hospital Level Studies

Author	Injury causes	Coding system
Carey & Laffoy, 2005	Falls	ICD-9-CM
Cassell & Clapperton, 2013	Falls	ICD-10-AM
Coronado et al., 2005	Falls	ICD-9-CM
	Motor vehicle accidents	
	Assault	
	Other	
Fletcher et al., 2007	All causes	ICD-9-CM
Hartholt et al., 2010	Falls	ICD-9
Hartholt, Stevens, et al., 2011	Falls	ICD-9-CM
Hartholt, Van Lieshout, et al., 2011	Falls	ICD-9
Harvey et al., 2012	All causes	ICD-10-AM
Kannus, Niemi, et al., 2018	Falls from 1m or less	ICD-9
		ICD-10
Kannus, Niemi, et al., 2005	Falls from 1m or less	ICD-9
		ICD-10
Kannus et al., 2007	Falls from 1m or less	ICD-9
		ICD-10
Kannus et al, 2009	Low trauma falls	ICD-9
		ICD-10
Kannus, Parkkari, et al., 2018	Falls from 1m or less	ICD-9
		ICD-10
Korhonen et al., 2012	Falls from 1m or less	ICD-9
		ICD-10
Mahoney et al., 2005	Falls	ICD-9
		ICD-10
Nilson et al., 2016	Falls	ICD-10
Olij et al., 2019	Falls	ICD-10
Oudshoorn et al., 2012	All causes	ICD-10
Parachute, 2015	Falls	ICD-10
Parachute, 2018	All causes	ICD-10
PHAC, 2014	Falls	ICD-10-CA
Scott et al., 2004	Falls	Unknown
Scott et al., 2010	Falls	ICD-10-CA
Soubhi et al., 2002	Falls	ICD-9-CM
Stevens et al., 1999	Falls	ICD-9
Thomson et al., 2003	Falls	ICD-9
	Motor vehicle accidents	
	Others	
Watson & Mitchell, 2011	Falls	ICD-10-AM

Note. ICD-9 = International Classification of Diseases, Ninth Revision. ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification. ICD-10 = International Classification of Diseases, 10th Revision. ICD-10-AM = International Classification of Diseases, 10th Revision, Australian Modification. ICD-10-CA = International Classification of Diseases, 10th Revision, with Canadian Enhancements.

Table 1-5

Rates of all Fall-Related Injuries in Hospital Level of Care Reported in Literature, Stratified by Age Groups and Sex

Age group (years)	65-69	70-74	75-79	80-84	85-89	90-94	65-74	75-84	65-79	80+	85+	90+	95+
Carey & Laffoy, 2005 [a]	F: 790 M: 460	F: 1,070 M: 490	F: 1,770 M: 770	F: 2,650 M: 1,370							F: 4,040 M: 1,940		
Hartholt et al., 2010 [b]	F: 495-609 M: 279-347	F: 738-890 M: 344-539	F: 1,170-1,570 M: 574-825	F: 1,980-2,770 M: 920-1,540	F: 3,047-4,504 M: 1,378-2,804	F: 3,829-5,655 M: 2,372-4,514							F: 4,596-7,215 M: 2,171-5,586
Hartholt, Stevens, et al., 2011	F: 323-467 [c] M: 261-333 [c]	F: 610-696 [c] M: 359-543 [c]	F: 1,038-1,362 [c] M: 707-914 [c]	F: 1,791-2,423 [c] M: 1,207-1,484 [c]							F: 3,636-4,283 [c] M: 2,447-2,878 [c]		
Kannus, Niemi, et al., 2005										F: 2,711-6,681 M: 1,441-4,726			
Kannus, Parkkari, et al., 2018										F: 2,753-5,843 [e] M: 1,475-4,115 [e]			
Korhonen et al., 2012										F: 2,729-7,079 [e] M: 1,455-5,467 [e]			
Nilson et al., 2016									F: 1,399-1,638 [d] M: 948-1,059 [d]	F: 5,787-6,035 M: 3,503-3,903 [c]			
Parachute, 2018	420	684	1,175							3,442			
PHAC, 2014	F: 570 M: 420	F: 920 M: 650	F: 1,640 M: 1,030	F: 2,900 M: 1,850	F: 4,810 M: 3,140							F: 6,860 M: 4,920	
Scott et al., 2010							F: 720 M: 520	F: 2,100 M: 1,310			F:5,210 M: 3,500		

Note. [a] Rates recalculated from per 1,000 to per 100,000. [b] Rates recalculated from per 10,000 to per 100,000. [c] Significant increase with time. [d] Significant decrease with time [e] Increased until 1990s, then decrease thereafter.

1.3.2.1 Injury Types and Body Locations

Table 1-6 shows the rates for injury types and body locations examined at the hospital level. Overall, fractures appeared to be the most common injury type. In Canada, hip fractures accounted for 38% of hospitalizations among older adults and 39% were other fractures (Scott et al., 2010). Similarly, 38% of fall-related hospitalizations were hip fractures in British Columbia between 1992 and 2001 (Scott et al., 2004). Females had higher counts and rates of fracture-related hospitalizations. In Sweden, the rate of fractures was 2,224 per 100,000 females and 1,072 per 100,000 males during the period of 2001-2010 (Nilson et al., 2016). Authors speculated that higher prevalence of osteoporosis and osteopenia in females could have contributed to higher rates of fractures (Hartholt, Stevens, et al., 2011; Orces, 2013).

Table 1-6

Types and Body Locations of Injuries in Hospital-Level Studies, Reported in Rates

Injury type and location	Carey & Laffoy, 2005			Cassell & Clapperton, 2013	Coronado et al., 2005	Fletcher et al., 2007	Hartholt, Stevens, et al., 2011
All FRIs	Total: 1,490 [h]	F: 1,960 [h]	M: 810 [h]	1,739-1,977 [b]			1,046-1,368 [b]
Fracture				1,251-1,327 [c]			
Hip				467-600 [c]			
Neck				6-18 [b]			
Skull/facial				17-32 [b]			
Upper limbs							
Proximal humerus							
Wrist/hand				11-14 [b]			
Forearm/elbow				138-157 [b]			
Shoulder/upper arm				118-151 [b]			
Lumbar spine/pelvis				135-158			
Pelvis							
Lower limb							
Lower leg/knee							
Lower leg/ankle				114-130			
Ankle/foot							
Foot				9-17 [b]			
Vertebrae							
Rib							
Rib/sternum/ thoracic spine				83-98 [b]			
Femur				37-50			
Other							
All non-fractures							
TBI				39-90 [b]	105	81-183	
Skull/brain injury							
Severe head injuries							
Open wounds				127-174 [b]			
Superficial injuries				95-123 [b]			
Dislocations, sprains, strains				49-59			
Muscle/tendon injures				13-22 [b]			
Other							

Injury type and location	Hartholt et al., 2010	Hartholt, Van Lieshout, et al., 2011			Kannus, Niemi, et al., 2018 [e]		Kannus, Niemi, et al., 2005 [e]		Kannus et al., 2007 [e]	
All FRIs	877-1,412 [a]						F: 2,711-6,681	M: 1,441-4,726		
Fracture										
Hip	512-636 [f]									
Neck										
Skull/facial										
Upper limbs										
Proximal humerus										
Wrist/hand										
Forearm/elbow										
Shoulder/upper arm										
Lumbar spine/pelvis										
Pelvis										
Lower limb										
Lower leg/knee										
Lower leg/ankle										
Ankle/foot										
Foot										
Vertebrae										
Rib										
Femur										
Other										
All non-fractures										
TBI										
Skull/brain injury		Total: 53-119	F: 59-127	M: 44-113						
Severe head injuries									F: 168-506	M: 172-609
Open wounds					F: 98-512	M: 92-395				
Superficial injuries										
Dislocations, sprains, strains										
Muscle/tendon injures										
Other										

Injury type and location	Kannus et al, 2009 [e]	Korhonen et al., 2012 [e]		Kannus, Parkkari, et al., 2018 [e]		Mahoney et al., 2005	Nilson et al., 2016	
All FRIs		F: 2,729-7,079 [f]	M: 1,455-5,467 [f]	F: 2,753-7,162 [f]	M: 1,475-5,503 [f]	2,159-2,263	F: 2,914-3,050 [c]	M: 1,646-1,677 [d]
Fracture							F: 2,224	M: 1,072
Hip								
Neck								
Skull/facial								
Upper limb								
Wrist/hand								
Proximal humerus	32-478 [g]							
Forearm/elbow								
Shoulder/upper arm								
Lumbar spine/pelvis								
Pelvis								
Lower limb								
Lower leg/knee								
Lower leg/ankle								
Ankle/foot								
Foot								
Vertebrae								
Rib								
Femur								
Other								
All non-fractures								
TBI								M: 225
Skull/brain injury								
Severe head injuries								
Open wounds								
Superficial injuries								F: 344
Dislocations, sprains, strains								
Muscle/tendon injures								
Other								

Injury type and location	Olij et al., 2019 [a]	Soubhi et al., 2002 [i]		Stevens et al., 1999		Watson & Mitchell, 2011
All FRIs		F: 1,919-2,173 [c]	M: 1,053-1,193 [c]			1,799-2,037 [b]
Fracture						1,356-1,171[c]
Hip	510-940 [c]			F 65-74: 501	M 65-74: 168	432-557 [c]
				F 75-84: 1,620	M 75-84: 682	
				F 85+: 3,958	M 85+: 2,256	
Neck						
Skull/facial						19-35 [b]
Upper limb	160-270 [d]	F: 270	M: 85			
Wrist/hand						10-16 [b]
Proximal humerus						
Forearm/elbow						199-161 [c]
Shoulder/upper arm						120-141 [d]
Lumbar spine/pelvis						
Pelvis						109-126 [b]
Lower limb		F: 1,068	M: 458			
Lower leg/knee						100-124 [d]
Lower leg/ankle						
Ankle/foot						11-17 [b]
Foot						
Vertebrae						63-91 [b]
Rib						64-79 [b]
Femur						37-45 [d]
Other	270-330 [d]					
All non-fractures						450-797 [b]
TBI						
Skull/brain injury	80-110 [b]					
Severe head injuries						
Open wounds		F: 59	M: 77			
Superficial injuries		F: 157	M: 105			
Dislocations, sprains, strains		F: 51	M: 44			
Muscle/tendon injures						
Other	250-430 [d]					

Note. F = Female. M = Male. [a] Rates recalculated from per 10,000 to per 100,000. [b] Significant increase with time. [c] Significant decrease with time. [d] Non-significant change with time. [e] Patients 80+ years only. [f] Increased until 1990s, then decrease until 2016. [g] Females only. [h] Rates recalculated from per 1,000 to per 100,000. [i] Rates reported per 100,000 person-years.

It appeared that increases in upper limb fractures, skull and facial fractures, rib fractures, ankle and foot fractures, TBIs, open wounds, and superficial injuries were responsible for the increase in FRI hospitalization rates (Cassell & Clapperton, 2013; Hartholt et al., 2010). Authors have speculated many causes for this apparent increase, such as poor nutrition and unhealthy habits, more coexisting chronic conditions, and an increased use of medications that may affect balance (Kannus, Niemi, et al., 2005; Kannus, Niemi, et al., 2018). Some explanations were contradictory. For example, in Finland, less-active lifestyles were considered as a cause of this increase (Kannus, Niemi, et al., 2005; Kannus, Niemi, et al., 2018), while in the Netherlands, Hartholt et al. (2010) suggested this trend may have been influenced by a greater number of older adults maintaining active lifestyles and having less functional limitations than in the past. Finally, a larger proportion of older adults continues to age at home, which could expose this population to greater risks for FRI (Harvey & Close, 2012; Nilson et al., 2016; Olij et al., 2019).

Two-part trends were identified in the Netherlands and Finland, an annual increase in the rate of FRI hospitalizations until the mid 1990s then a decrease or stabilization of rate thereafter (Hartholt et al., 2010; Kannus, Parkkari, et al., 2018; Korhonen et al., 2012). Conversely, there was a decline in age-standardized rates with time in Ireland, Sweden, and the Netherlands. Collectively, these studies did not provide sufficient evidence to explain the variability in hospitalization rate changes over time. Some authors speculated that more active lifestyles could have resulted in increased balance, coordination, and muscular performance (Kannus, Parkkari, et al., 2018; Korhonen et al., 2012; Kannus, et al., 2009). It is also possible that there has been a shift towards improved treatment of injuries by general practitioners outside of hospitals for less severe FRIs (Carey & Laffoy, 2005; Olij et al., 2019). Hartholt and colleagues (2010) proposed that the deceleration in all FRI hospitalizations since the mid-1990s could be due to a decline in specific injury types, such as hip fractures, though the reason for this decline was uncertain.

1.3.2.2 Fractures

Table 1-6 shows the rates for injury types and body locations examined at the hospital level. Fractures were the most common injury type (Cassell & Clapperton, 2013; Watson

& Mitchell, 2011). Overall, females had higher counts and rates of fracture-related hospitalizations. Between 2001 and 2010 in Sweden, the rate of fractures was 2,224 per 100,000 females and 1,072 per 100,000 males (Nilson et al., 2016). Authors speculated that higher prevalence of osteoporosis and osteopenia in females could have contributed to higher rates of fractures (Hartholt, Stevens, et al., 2011; Orces, 2013). A consensus finding was that the hip was the most commonly fractured body part (Carey & Laffoy, 2005; Hartholt et al., 2010; Olij et al., 2019; Watson & Mitchell, 2011), especially in females (Cassell & Clapperton, 2013; Stevens et at., 1999).Rates of hip fractures ranged from 432 to 940 per 100,000 across reviewed studies (Table 1-5).

Though fractures remain the most common injury type, the proportion of fractures, including hip fractures, compared to other injury types have decreased over time in Australia and the Netherlands (Cassell & Clapperton, 2013; Hartholt et al., 2010; Olij et al., 2019; Watson & Mitchell, 2011). With time, hip fracture rates have decreased from 1,800 to 1,330 per 100,000, while fractures of the upper extremities and other fractures did not significantly change between 1997 and 2016 in the Netherlands (Olij et al., 2019). Other fracture types resulted in varying time-related trends. Watson and Mitchell (2011) reported that rates of forearm and elbow fractures decreased with time, while fractures of the skull and face, vertebrae, pelvis, wrist and hand, ankle and foot, and ribs increased over time.

1.3.2.3 Traumatic Brain Injury and Other Head Injuries

Like fractures, there were sex-related differences in patients with head injuries (Table 1-5), namely rates were higher in males than females (Carey & Laffoy, 2005; Coronado et al., 2005; Fletcher et al., 2007; Harvey & Close, 2012; Kannus et al., 2007; Parachute 2015). TBI-related hospitalization rates also increased with advancing age and peaked in the oldest age groups (Coronado et al., 2005; Fletcher et al., 2007; Hartholt, Van Lieshout, et al., 2011; Kannus et al., 2007; Nilson et al., 2016; Parachute, 2018).

Time-trends indicated that the number and age-standardized rates of TBIs have increased with time in Australia, Finland, the Netherlands, and the United States (Cassell & Clapperton, 2013; Fletcher et al., 2007; Hartholt et al., 2010; Hartholt, Van Lieshout, et al. 2011; Harvey & Close, 2012; Kannus et al., 2007; Olij et al., 2019). Several studies speculated that the increase could be partly explained by the more widespread use of

computerized tomography scanning, resulting in a greater detection of TBIs (Cassell & Clapperton, 2013; Hartholt, Van Lieshout, et al., 2011; Harvey & Close, 2012; Olij et al., 2019; Watson & Mitchell, 2011). Harvey and Close (2012) also suggested that an increase in the use of anticoagulant and antiplatelet medications could contribute to more intracranial bleeds. As for TBI types, Coronado and colleagues (2005) found that intracranial haemorrhages were the most common TBI, followed by concussions, while Hartholt, Van Lieshout, et al. (2011) found that concussions and contusions were the most common head injury categories, followed by fractures and bleeds (haemorrhages).

1.3.2.4 Other Injuries

Open wounds were the second most common injury type in Australia with age-standardized rates rising from 127 in 1998/1999 to 174 per 100,000 in 2008/2009 (Cassell & Clapperton, 2013). Unlike fractures, the rates for open wounds were higher among males in all age groups and increased with advancing age in both sexes in Canada (Soubhi et al., 2002). Kannus, Niemi, et al. (2018) also reported an increase with both time and advancing age among Finns aged 80+ years, and rates were consistently higher in females (98 in 1970 to 512 per 100,000 in 2014) than males (92 to 395 per 100,000).

Superficial injuries were the third most common injury type in Australia, with rates increasing from 95 in 1998/1999 to 123 per 100,000 in 2008/2009 (Cassell & Clapperton, 2013). Superficial injuries were the second most common injury type (after fractures) in British Columbia, Canada (Soubhi et al., 2002). Sex-specific rates for superficial injuries were higher in females for all age groups and increased with advancing age groups (Soubhi et al., 2002). Rates of fall-related sprains, strains, and dislocations ranged from 49 to 59 per 100,000 in Australia and did not show a significant change over time (Cassell & Clapperton, 2013). Overall, injury types besides fractures appear to be contributing to the rise in FRI hospitalization rates, specifically open wounds and superficial injuries are problematic among older adult populations.

1.3.3 Mortality

A consensus finding in this review was that the number and rate of mortality due to FRIs have increased with time (Alamgir et al., 2012; Mahoney et al., 2005; PHAC, 2014; Stevens et al., 1999; Stevens & Dellinger, 2002). Rates varied by sex and age and were higher among males than females and increased with older age groups (Alamgir et al.,

2012; Mahoney et al., 2005; Orces, 2008; PHAC, 2014; Stevens et al., 1999; Stevens & Dellinger, 2002). Authors speculated that higher rates in males could be related to males engaging in more physical activities or risky behaviours, and that males suffer from more comorbidities (Alamgir et al., 2012; Orces, 2008). Conversely, age-standardized rates were found to be higher among females in the Netherlands and United States (Olij et al., 2019; Stevens et al., 1999). Findings from Canada, the Netherlands, and Austria, also confirmed that mortality rates increased with advancing age (Brazinova, et al., 2015; Olij, et al., 2019; PHAC, 2014; Scott et al., 2004). Table 1-7 shows FRI mortality rates from the literature by age groups and sex where possible.

Table 1-7

Fall-related Injury Mortality Rates from Peer-reviewed Literature and Canadian Reports, Reported by Age Groups

Age group (years)	Alamgir et al., 2012	Olij et al., 2019 [a]	Orces, 2008 [a]		PHAC, 2014 [a,d]	Soubhi et al., 2002 [e]		Stevens & Dellinger, 2002 [a]	
65+		107-121	F: 19-23	M: 29-45	35-47	F: 52	M: 52	F: 19-26	M: 24-31
65-69	9		F: 1-4 [c]	M: 7-8 [c]	8-10	F: 6	M: 10		
64-74		15-21							
70-74	16		F: 6-10 [b]	M: 10-15 [c]	14-18	F: 10	M: 20		
75-79	32		F: 12-16 [c]	M: 17-29 [b]	27-37	F: 29	M: 42		
75-84		89-103							
80-84	64		F: 26-40 [b]	M: 26-69 [b]	60-86	F: 70	M: 95		
85-89					131-175				
85+	150	554-780	F: 62-97 [b]	M: 71-158 [b]		F: 288	M: 320		
90+					278-417				

Note. F = Female. M = Male. [a] Range of rates provided for articles that included multiple rate calculations during study period. [b] Significant increase with time.. [c] Non-significant change with time. [d] Rates recalculated from per 10,000 to per 100,000. [e] Rates reported per 100,000 person-years.

1.3.4 Types and Locations of Falls

The following sections present findings from literature that described the types of falls that resulted in injury. As before, only falls that resulted in admission to the ED or hospital were examined. Where possible, fall types were separated by demographic characteristics and injury types.

1.3.4.1 Emergency Department Level of Care

According to Parachute 2018 report, in Ontario (2014-2016) 'other/unspecified' falls (ICD-10 codes W03, W05, W11, W12, W15, W16, W17, W18, W19) were the most common fall type, followed by 'fall on the same level from slipping, tripping, and stumbling' (W01), 'fall on and from stairs and steps' (W10), 'fall involving bed, (W06), and 'fall on same level involving ice and snow' (W00). These rates are displayed in Table 1-8 by age group. Another Parachute (2016) report examined FRIs due to 'fall on and from stairs and steps' (W10) and found the rate to range between age groups from 440 per 100,000 (65-74 years) to 658 per 100,000 (75 + years). The most frequent location of FRI events was the home. In the Netherlands in 2016, Olij et al. (2019) reported that most FRI events occurred in and around the home (1,640 per 100,000), followed by in the street (330 per 100,000), and in nursing homes (270 per 100,000).

Table 1-8
Rates of Patients admitted to the Emergency Department in Ontario as a Result of Experiencing Different Types of Falls, Reported by Age Group (April 2014 to March 2016), Adapted from Parachute, 2018

Age group (years) [a]	65-69	70-74	75-79	80+
Other/unspecified	1,275	1,630	2,425	6,124
Slip, trip, stumble (W01)	1,005	1,292	1,790	3,443
Stairs/steps (W10)	429	507	603	771
Ice/snow (W00)	205	224	240	201
Bed (W06)	69	115	198	615
Chair (W07)	47	70	108	270
Other furniture (W08)	17	21	31	61

Note. Rates reported per 100,000 population. ICD-10 codes used for fall type classification. [a] Other/unspecified = W03, W05, W11, W12, W15, W16, W17, W18, W19. Adopted from Parachute, 2018

1.3.4.2 Hospital Level of Care

Three types of falls accounted for 96% of FRIs that required hospitalization in the Netherlands; 'accidental fall on same level from slipping, tripping, stumbling', 'accidental fall on or from stairs or steps', or 'fall near a bed or chair' (Hartholt et al.,

2010). Similarly, Mahoney et al. (2005) reported that falls due to ‘slipping, tripping, and stumbling’, followed by ‘falling from one level to another’, and falls from ‘stairs or steps’ were among the most common categories of falls. Fall types related to slipping or tripping were among the most common in British Columbia (Soubhi et al., 2002), Ontario (Parachute, 2018), and Canada as a whole (Soubhi et al., 2002). However, Parachute (2018) combined codes for ‘other’ and ‘unspecified’ falls (ICD-10 W03, W05, W11, W12, W15-W19), which together were the most common fall category in Ontario older adults. Soubhi et al. (2002) reported that ‘other/unspecified’ falls were the second most common fall type in British Columbia. ‘Falls on and from stairs and steps’ (W10) were also among the common fall types (CIHI, 2011; Parachute, 2018). In Ontario, rates of FRI hospitalizations due to ‘falls on same level from slipping, tripping, and stumbling’ increased from 116 (65-69 years) to 983 per 100,000 (80+ years) while ‘falls on and from stairs and steps’ increased from 55 to 210 per 100,000 in the same age groups (Parachute, 2018).

In Australia, ‘fall on same level from slipping, tripping, or stumbling’ and falls ‘due to a collision with another person’ were the most common fall types that resulted in TBI and together accounted for 64.2% of hospitalizations (Harvey & Close, 2012). Another Australian study reported that hip fractures were often caused by any ‘same level falls’ (ICD-10 codes W00-W08, W17) with a rate of 291 per 100,000 in 2008/2009 (Cassell & Clapperton, 2013). An important takeaway from this section on fall types is that, although the comparable coding classification systems were used in reviewed studies (ICD-9 and ICD-10), the authors combined various fall types into a single category, making comparison across studies imprecise. However, same-level fall events, including slipping and tripping, were consistently the most common fall type at the hospital level of care.

The home was the most common location of fall-related hip fractures and TBIs in Australia, followed by residential institutions (Harvey & Close, 2012; Cassell & Clapperton). In Canada, approximately 50% of FRIs that required hospitalization occurred in or around the home, and about 20% occurred in residential institutions (PHAC, 2005). Scott and colleagues (2010) also reported that 17% FRIs occurred in ‘unspecified’ locations. In summary, population-based studies of FRI hospitalizations

have not placed a heavy focus on fall types or fall locations; rather, they have focused on describing injury types and the individuals who experienced the injurious events.

1.3.5 Limitations of the Current Literature

Several common limitations were identified in the reviewed population-based studies. As researchers used secondary data, meaning they did not personally collect data, they had to accept potential errors or missing data during data entry (Watson & Mitchell, 2011). Underreporting of FRIs is also possible for a few reasons. For example, if the FRI was not listed as the primary diagnosis it could have been misclassified (DeGrauw et al., 2016; Nilson et al., 2016; Orces, 2013; Stevens et al., 2009; Watson & Mitchell, 2011). Additionally, studies that examined only FRIs that required hospitalization may have underestimated the impact of FRIs on the entire healthcare system, as some serious injuries treated and discharged from ED or outpatient clinics were not included (Carey & Laffoy, 2005; Hartholt, Stevens, et al., 2011; Harvey & Close, 2012; Kannus, Parkkari, et al., 2018; Nilson et al., 2016).

Changes in coding (i.e., from ICD-9 to ICD-10) during a study period could influence results, especially in multi-decade observation periods (Olij et al., 2019). Converting from one classification system to another over time results in difficulty in drawing comparisons within a study as well as across studies from different years. Results from a single country, province, or state, may not be generalizable to other populations due to differences in healthcare systems or population demographics (Hartholt et al., 2010; Hartholt, Van Lieshout, et al., 2011; Olij et al., 2019). Finally, there is a concern that in FRIs research using large population-based datasets a considerable portion of missing or unspecified codes for causes of injuries, such as ‘unspecified’ fall types or locations, might impact findings (Harvey & Close, 2012).

1.3.6 Literature Review Summary

This literature review examined peer-reviewed articles and Canadian injury reports that described population studies of FRIs at the ED and hospital levels of care. The takeaway from this review is that drawing conclusions and making comparisons about all FRI research is not feasible. There is a great diversity in reporting procedures, such as varying categorizations of injury types and fall types drawn from ICD-9 and ICD-10 coding. It is unclear if researchers devised these categorizations (e.g., grouping multiple fall type

codes into a single ‘falls on same level’ category) or if they are a limitation of secondary datasets used.

This literature review sought to answer three questions. The first was: What is known about people who experience FRIs? Simply put, the answer is ‘not enough’. Overall, females have higher rates of FRIs than males, and in most injury types, the age-specific rate increased with advancing age. This is true for patients with the most frequently studied injury types, such as fractures and TBIs. What is not known however, is who is experiencing the less common and less serious injuries, like superficial injuries, open wounds, and other fractures (e.g., rib).

The second question asked: What types of FRIs are occurring in older adults? Fractures were the most common injury type, typically accounting for more than one-third of all FRI observations. The other injury types frequently examined were TBI and other head injuries, which is understandable given the propensity for these injury types to influence the health and function of older adults. However, other injury types, such as fractures of the rib, sternum and thoracic spine, were not described in great detail. It is possible to separate and individually examine these injuries using ICD-10 coding; however, they are often combined and described as a single entity. Separating these injuries would help shift towards a person-centered approach to care. These injuries have different consequences for individuals who experience them and should be targeted for prevention with the same care as more common injury types.

The third question asked: How did rates of FRIs change over time? Inconclusive time trends were uncovered in the literature. Increases in FRI rates at the ED were seen in some countries (e.g., United States), while a decline was present in others (e.g., the Netherlands). However, one consistent finding stood out; the proportion of fractures compared to other FRIs appears to have declined over time, meaning that other injury types seen in the ED are taking over increase in FRI rates. What is causing this shift in common injury types remains uncertain.

Finally, what types of falls caused FRIs? Overall, fall types were difficult to compare across studies as multiple types were often combined into a single category. However, it appeared that falls on the same level, specifically, ‘fall on same level from

slipping, tripping and stumbling' (W01) was the most frequently seen fall type at both ED and hospital levels of care.

1.3.7 Recommendations from Literature for Future Research and Fall-Related Injury Prevention

The reviewed literature provided numerous recommendations for future research and fall injury prevention strategies, as summarized below.

1. Identify if demographic characteristics influence the types of injuries experienced (Hartholt et al., 2010; Nilson et al., 2016).
2. Conduct more ED-level population studies to better understand FRIs that do not require hospitalizations (Watson & Mitchell, 2011).
3. Design population-based epidemiological studies that will aid in informing decision-makers on how healthcare resources should be allocated and to plan for future healthcare needs (Hartholt, Stevens, et al., 2011).
4. Further investigate the circumstances and locations of FRI events which will shed light on risk factors for FRIs so that fall and FRI prevention strategies can be tailored to meet increasing needs (Stevens et al., 2009; Watson & Mitchell, 2011).
5. Explore the use of hip protectors as a strategy to reduce the likelihood of fracturing a hip in the event of a fall (Kannus, Niemi, et al., 2018; Kannus et al., 2009; Korhonen et al., 2012).

1.4 Purpose

The literature review identified three major gaps. The first was a lack of population-based research of FRIs in Ontario and Canada. The 2018 Ontario Injury Data Report (Parachute, 2018) outlined the types of falls that resulted in injury at both the ED and hospital levels of care, however it did not examine injury types. The second gap was the need to better describe the demographic characteristics of the individuals who experienced FRIs. The third gap was the need to describe in detail both the types of injuries and the types of falls that caused injuries as specific details are essential for targeted FRI prevention strategies.

The purpose of this descriptive population-based study was to describe the FRIs among older adults admitted to EDs in Ontario, Canada, as well as people who were subsequently hospitalized. The specific goals of this study aligned with the first, second,

and fourth recommendations from the literature listed above. These goals were: 1) to provide demographic characteristics of the people who experienced different FRIs and were admitted to the ED and hospital for treatment, and 2) to describe the types of falls resulting in injury. The second chapter outlines research methods used in this thesis, and the third chapter describes findings from this study. The final chapters, discussion and conclusions, tie in findings from both the previous literature and this original study.

2. Methods

2.1 Study Design

This retrospective population-based descriptive study was conducted using data from three linked administrative databases housed at IC/ES (formerly known as the Institute for Clinical Evaluative Sciences) in the province of Ontario, Canada.

2.2 Dataset Creation

This section describes the origin of the databases used to create this study's dataset as well as their contents. The databases used originated from the Canadian Institute for Health Information (CIHI), which gathers healthcare data from regional health ministries or authorities, and from community and hospital facilities (CIHI, 2011; Chan et al., 2013). This data is cleaned and validated by CIHI (Ontario Ministry of Health and Long-Term Care, 2012), then made accessible to IC/ES.

IC/ES [3] is an independent, non-profit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyze healthcare and demographic data, without consent, for health system evaluation and improvement. IC/ES is a prescribed entity under section 45 of Ontario's Personal Health Information Protection Act. Section 45 authorizes IC/ES to collect personal health information, without consent, for the purpose of analysis or compiling statistical information with respect to the management of, evaluation or monitoring of, the allocation of resources to or planning for all or part of the health system. Projects conducted under section 45, by definition, do not require review by a Research Ethics Board. This project was conducted under section 45 and approved by IC/ES' Privacy and Legal Office. Ethics approval for this study was required by Western University and was obtained from the Research Ethics Board at Western University (HSREB # 109335, Appendix A).

This dataset was created by extracting patient data from two databases from IC/ES: National Ambulatory Care Reporting System (NACRS) and Discharge Abstract Database (DAD). NACRS contains closed cases from community and hospital-based ambulatory care, including day surgery, outpatient and community clinics, and ED data,

[3] Italicized portions of text are a required wording provided by IC/ES and obligatory for inclusion in studies using IC/ES data.

though only data from the ED level was included in this study. DAD contains hospital inpatient records including administrative, demographic, and clinical patient information at the point of patient discharge, death, or transfer (Ontario Ministry of Health and Long-Term Care, 2012). Together, NACRS and DAD provided a comprehensive overview of multiple levels of healthcare that an individual may require at the time of an FRI.

A Dataset Creation Plan (Appendix B) with information for data requirements for this and another four studies was created and submitted to IC/ES. This study focused on the five-year period from 2010 to 2014 inclusive. The Dataset Creation Plan was submitted to IC/ES and a data analyst created algorithms to extract the data from NACRS and DAD. A third dataset was provided, the Ontario Registered Persons Database (RPDB), which contains sociodemographic information for Ontario residents. The research team received a "Master" dataset and a "Full" dataset in addition to NACRS and DAD datasets. Sociodemographic information from RPDB (e.g. age, sex, local health integration network [LHIN], nearest neighbourhood income quintile) and five chronic condition codes (i.e. asthma, chronic obstructive pulmonary disease [COPD], dementia, diabetes, hypertension) populated the Master dataset. There are 14 LHINs in Ontario that align with a geographic region of the province. Nearest neighbourhood income quintiles are based on census data and attribute average household income to individuals living in a dissemination area, that is, a small geographic area (CIHI, 2018). Quintile one refers to the least affluent, quintile five represents the highest average household income, while each quintile contains about 20% of the dissemination area. Every Ontario resident eligible to receive health care is assigned a unique encoded identifier known as an IC/ES key number which allows all IC/ES datasets to be linked (IKN; Iron et al., 2008). The "Full" dataset contained ICD-10-CA codes (CIHI, 2015), including at least one injury (S00-S99 or T00-T14) and one fall (W00-W19) code per observation were included.

2.3 Population Inclusion and Exclusion Criteria

The population of interest included all older adult Ontario residents who were admitted to an Ontario ED for an FRI. The inclusion criteria were: (1) older adults age 65 years or older at the time of admission to ED, (2) who were diagnosed with an FRI or died as a result of FRI, (3) between January 1, 2010 and December 31, 2014. An FRI was defined as a combination of two ICD-10-CA diagnosis codes; namely, a diagnosis of an injury,

defined by ICD-10-CA codes S00-S99 or T00-T14 codes, and diagnosis of a fall, defined by ICD-10-CA codes W00-W19. Patients were excluded from the study if they: (1) did not have a valid IKN, (2) died prior to ED admission, (3) were not residents of the province of Ontario, (4) were younger than 65 years at the index date, (5) or have experienced an FRI as a hospital inpatient. The index date was operationally defined as the date of the first health care record for a patient diagnosed with an FRI.

2.4 Data Cleaning

Data cleaning and statistical analysis were conducted using R version 3.3.0 (R Core Team, 2016). Data cleaning was initiated by merging the "Full" and "Master" datasets by "Study_ID", the variable name for IKNs, using the merge() function (R Core Team, 2016). The merged dataset, further referred to as the "Master-Full" dataset, was then filtered to ensure only observations with FRI diagnoses were included. Using the R function called filter() (Wickham & Francois, 2015), the control group data (used in other studies) was removed, thus only FRI cases were retained. The Master-Full dataset was further filtered to ensure all observations included diagnosis codes for a fall (W00-W19) and an injury (S00-S99 or T00-T14). The variable called "Days from index date to registration date" had to have a value of zero, meaning a patient was registered at the ED on the same day as the index date (i.e. the date when the first health care records for a patient's FRI were recorded), ensuring that treatment was indeed for an FRI. An age group variable called "agegroups" created using the setDT() function (Dowle, et al., 2015), which grouped observations into five-year age groups ranging from 65-69 years to 90+ years. The 90+ years group was based on the IC/ES requirement to cap the upper age maximum in this dataset to age 91 due to privacy policy.

Next, NACRS and DAD were then merged separately with the Maser-Full dataset to extract only FRI cases from ED and hospital. The final step was to remove multiple observations for the same "Study_ID" to ensure there was only one observation per person or IKN. Using the distinct() function, only the first observation per "Study_ID" was saved into a data frame for each dataset (Wickham & Francois, 2015), thus eliminating any duplicate observations.

2.5 Data Analysis

Descriptive statistics, measures of central tendency, and frequency of categorical variables were calculated. Prevalence rates were calculated for the total population and were further stratified by age groups and sex. Rates were reported for injury types and fall types based on ICD-10-CA codes. These codes can be found in Appendix C. Since this dataset included observations from a five-year period, rates were calculated for this entire period (2010-2014, inclusive) unless otherwise specified. Crude rates were calculated using the total number of observations of a specific event (e.g. all FRIs, only fractures) over the five years as the numerator, and the sum of the annual Ontario population estimates as the denominator, then multiplied by 100,000. These population rates were derived from intercensal Ontario population estimates from Canadian census data (Statistics Canada, n.d.) and were used to report rates for the entire older adults population, including all age groups and sexes. Rates that were calculated for a single year used the population estimate for said year as the denominator. An example calculation of the crude rate of all FRIs between 2010 and 2014 is provided:

$$\text{Crude Rate} = \left(\frac{\text{Sum of all FRI observations}}{\text{Sum of older adult population, 2010-2014}}\right) \times 100{,}000$$
$$= \left(\frac{304{,}610}{9{,}860{,}384}\right) \times 100{,}000$$
$$= 3{,}089 \text{ per } 100{,}000$$

Sex-specific rates were calculated using the number of observations per sex as the numerator and population estimates per sex as the denominator while age-specific rates were calculated using the number of observations per age group (numerator) and the population estimates for the same age group (denominator). An example calculation of an age- and sex-specific rate is provided:

$$\text{Age- and Sex- Specific Rate} = \left(\frac{\text{Sum of all fractures among females aged 65 to 69}}{\text{Sum of female population 65 to 69 years, 2010-2014}}\right) \times 100{,}000$$
$$= \left(\frac{18{,}473}{1{,}597{,}315}\right) \times 100{,}000$$
$$= 1{,}157 \text{ per } 100{,}000$$

Population estimates were derived from Ontario intercensal annual population estimates from Statistics Canada, based on the 2006 and 2011 Canada-wide censuses (Statistics Canada, n.d.). These population estimates were stratified by sex, five-year age group, and for each year between 2010 and 2014 (Appendix D). Additionally, age-standardized rates were calculated using direct standardization. Both rates were calculated so findings from this study could be compared to those from FRI literature which used either age-specific or age-standardized rates. Direct standardization means that age-specific rates were calculated as described above for each of the five-year age groups. The age-specific rates were then multiplied by the proportion, or weight, of each age group from a separate population, such as a census, called the standard population. The 2011 Canadian Census of the older adults in Ontario (Appendix E, Table E1; Statistics Canada, 2019) was the standard population for this study as 2011 was the only census year during the study period. The sum of these calculations is the age-standardized rate. An example calculation for age-standardized rate of all FRIs at the ED is calculated below, using the weights from the standard population displayed in Appendix E.

$$\begin{aligned}\text{Age-Standardized Rate} = {} & (\text{Age-specific rate for 65 to 69 group} \times \text{Weight}) \\ & + (\text{Age-specific rate for 70 to 74 group} \times \text{Weight}) \\ & + (\text{Age-specific rate for 75 to 79 group} \times \text{Weight}) \\ & + (\text{Age-specific rate for 80 to 84 group} \times \text{Weight}) \\ & + (\text{Age-specific rate for 85 to 89 group} \times \text{Weight}) \\ & + (\text{Age-specific rate for 90+ group} \times \text{Weight}) \\ = {} & 3{,}097 \text{ per } 100{,}000\end{aligned}$$

Age-standardized rates minimize the affects of age structure in this population, thus allowing for comparison between different geographical regions or between different time periods (Statistics Canada, 2017b). For this study, it was not possible to calculate age-standardized rates for all results as there were some injury or fall types that had five or fewer observations in at least one age group or sex. Results that had five or fewer observations could not be reported to maintain patient anonymity. All rates in this study were expressed per 100,000 population.

LHINs were examined in this study to identify if rates of FRIs varied by geographic region. The crude rate of FRIs per LHIN was calculated for 2013 only because the population of older adults per LHIN, used as denominator (Appendix F, Table F1) was only available from Ontario health regions for December 2013 (Statistics Canada, 2017a).

Rates of patients who died within a year of FRI event were calculated using a variable ('Days_to_dthdate') which identified the number of days from the index date to the date of death. The dataset did not include information on official cause of death; therefore, it was not possible to ascertain if FRI was a contributing cause of death. This section describes how long after experiencing an FRI the patient died, not how or why. Patients that died any time during the observation period to the date of dataset creation (September 2019) were given a value of zero (meaning they died on same day as index date) or greater. For this study, only deaths within one year of the ED admission were examined. Pearson's Chi-squared tests with Yates' continuity correction were calculated on counts of binary variables, with a significance level of $p < 0.05$. Specifically, differences in sexes for various injury types were calculated using this method to identify if the number of females and males who had specific injury types were significantly different.

Injury types were categorized by the author into fractures, superficial injuries, open wounds, 'sprains, strains, or tears of cartilage, joint capsule, or ligaments', dislocations, muscle and tendon injuries (including avulsion, cut, laceration, and traumatic rupture of muscle, fascia, and tendon), internal organ injuries, injuries of the eye and orbit that could not be categorized into the above injury categories, and other or unspecified injuries based on ICD-10-CA codes for injuries (S00-S99 and T00-T14). These categories were created as there are too many ICD-10-CA codes to analyze them all individually. These categories also allowed for meaningful analysis and comparison between observations with different demographic characteristics (e.g. age group, sex, LHIN) in this study as well as comparison to other similar studies. The ICD-10-CA codes used to define injury types are described in Appendix C.

3. Results

The results chapter consists of three sections. The first focuses on patients with FRIs who entered the health care system at the ED. The following section describes the FRIs among patients who were subsequently hospitalized after the ED. The final section focuses on the types and locations of falls that caused injuries requiring both ED admission and hospitalization.

3.1 Emergency Department Level of Care

3.1.1 Demographics

There was a total of 304,610 observations of FRIs among older adults in Ontario in the five-year period between January 1st, 2010 and December 31st, 2014, and 63.0% were females. The overall mean age of patients was 77.6 (8.2) years, and was slightly higher in females, 78.0 (8.3) years, than males, 77.0 (7.9) years. Table 3-1 includes the count, percent, and rates of all ED admissions by demographic characteristics. The greatest number of ED admissions for FRIs occurred in the youngest group (65 to 69 years) and the fewest number of observations were in the oldest group (90+ years). Age-specific rates increased with advancing age in both sexes and were higher in females for all age groups except the 90+ year group. Rates for females increased from 2,572 (65-69 years) to 6,508 per 100,000 (90+ years), while rates for males more than tripled from 1,813 to 6,665 per 100,000 in the same age groups (Figure 3-1). Sex-specific rates of FRIs among patients with all five chronic conditions were higher in females than males (Appendix G, Figure G1). Greater detail on FRIs among patients with chronic conditions can be found in Appendix H. Crude rates for all 14 LHINs in 2013 are displayed in Table 3-2. The Central West LHIN had the lowest rate of FRIs at the ED, while the rate in the North West LHIN was 30% higher. Rates were also high among the South East and North East LHINs.

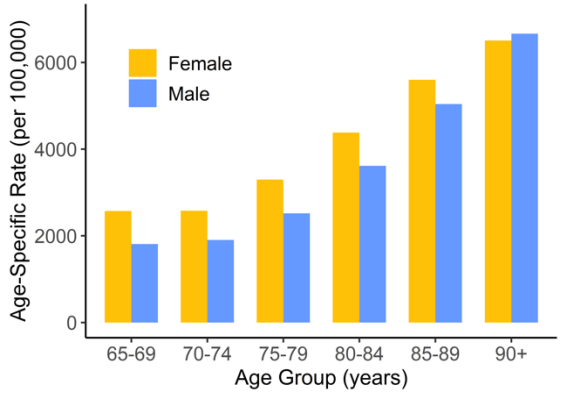
Table 3-1

Demographic Characteristics of Population of Older Adults with Fall-Related Injuries Seen in the Emergency Department (2010-2014)

Demographic Characteristic	Injuries N (% [a])	Rate (per 100,000)
Total [b]	304,610 (100.0)	3,089
Sex [c]		
Female	192,044 (63.0)	3,503
Male	112,566 (37.0)	2,572
Age group (years) [d]		
65-69	67,837 (22.3)	2,208
70-74	51,958 (17.1)	2,264
75-79	53,384 (17.5)	2,947
80-84	56,008 (18.4)	4,059
85-89	46,185 (15.2)	5,399
90+	29,238 (9.6)	6,552
Chronic conditions [b]		
Asthma	45,818 (15.0)	465
COPD	81,022 (26.6)	822
Dementia	45,994 (15.1)	466
Diabetes	92,490 (30.4)	938
Hypertension	230,958 (75.8)	2,342
LHIN [b]		
1. Erie St. Clair	16,365 (5.4)	-
2. South West	26,734 (8.8)	-
3. Waterloo Wellington	14,938 (4.9)	-
4. Hamilton Niagara Haldimond Brant	38,675 (12.7)	-
5. Central West	12,210 (4.0)	-
6. Mississauga Halton	19,790 (6.5)	-
7. Toronto Central	24,294 (8.0)	-
8. Central	33,962 (11.1)	-
9. Central East	35,953 (11.8)	-
10. South East	16,171 (5.3)	-
11. Champlain	29,450 (9.7)	-
12. North Simcoe Muskoka	12,258 (4.0)	-
13. North East	17,079 (5.6)	-
14. North West	6,731 (2.2)	-
Nearest neighbourhood income quintile [b]		
1	62,980 (20.7)	-
2	63,268 (20.8)	-
3	59,370 (19.5)	-
4	58,998 (19.4)	-
5	58,926 (19.3)	-
NA	1,068 (0.4)	-
Deaths within days following ED admission [b]		
Same day	254 (0.1)	3
One day	715 (0.2)	7
Three days	1,647 (0.5)	17
One week	3,235 (1.1)	33
One month [e]	8,264 (2.7)	84
Six months [f]	22,427 (7.4)	227
One year	33,054 (10.9)	335

Note. COPD = Chronic Obstructive Pulmonary Disease. LHIN = Local Health Integration Network. ED = Emergency Department. [a] Denominator to calculate percentages = 304,610. [b] Crude rates were calculated with total number of observations as the numerator and the sum of Ontario's population over the five years as the denominator. [c] Sex-specific rates were calculated with total number of observations per sex as the numerator and the sum of Ontario's population over the five years per sex as the denominator. [d] Age-specific rates were calculated with total number of observations per age group as the numerator, and the sum of Ontario's population over the five years per age group as the denominator. [e] One month = 30 days. [f] Six months = 183 days. Percentages of chronic conditions do not add to 100 as it was possible for patients to be diagnosed with more than one condition.

Figure 3-1
Patients with Fall-Related Injuries Seen in the Emergency Department by Age Group and Sex (2010-2014)



Note. Age-specific rates were calculated with total number of observations per sex and age group as the numerator, and the sum of Ontario's population over the five years per sex and age group as the denominator.

Table 3-2
Crude Rates of Fall-Related Injuries per Local Health Integration Network seen in Emergency Departments for 2013 Only

LHIN	N	Rate
1. Erie St. Clair	16,365	3,269
2. South West	26,734	3,488
3. Waterloo Wellington	14,938	3,256
4. Hamilton Niagara Haldimond Brant	38,675	3,385
5. Central West	12,210	2,889
6. Mississauga Halton	19,790	3,179
7. Toronto Central	24,294	3,320
8. Central	33,962	3,153
9. Central East	35,953	3,330
10. South East	16,171	3,585
11. Champlain	29,450	3,449
12. North Simcoe Muskoka	12,258	3,302
13. North East	17,079	3,503
14. North West	6,731	3,749

Note. LHIN = Local Health Integration Network. Crude rates were calculated using the total number ED FRI observations per LHIN in the year 2013 as the numerator and the population of older adults per LHIN in 2013 as a denominator. Rates were reported per 100,000.

3.1.2 Injury Types

The most common injury types were fractures, superficial injuries, and other or unspecified injuries, which was consistent for females and males (Table 3-3). Overall, lower limb, upper limb, and head injuries were seen in the greatest proportion of patients, although these proportions fluctuated with age group (Appendix I, Table I2). Table 3-3 shows the counts, rates, and percentages of patients with different injury types by sex.

Table 3-3
Patients Who were Admitted to the Emergency Department for Various Fall-Related Injury Types by Sex (2010-2014)

Injury Type	Total		Female		Male		p value
	N	Rate [a]	N (%)	Rate [b]	N (%)	Rate [b]	
Fracture	121,687	1,234	85,851 (70.6)	1,566	35,839 (29.4)	819	<0.0001
Superficial	70,887	719	43,093 (60.8)	786	27,794 (39.2)	635	<0.0001
With other injury	10,311	105	6,458 (62.6)	118	3,853 (37.4)	88	NS
Superficial only	60,576	614	36,635 (60.5)	668	23,941 (39.5)	547	<0.0001
Other, unspecified	56,449	572	34,508 (61.1)	629	21,941 (38.9)	501	<0.0001
Open wound	49,148	498	26,068 (53.0)	475	23,080 (47.0)	527	<0.0001
Sprain, strain, tear	15,929	162	10,158 (63.8)	185	5,771 (36.2)	132	NS
TBI	8,595	87	4,232 (49.2)	77	4,363 (50.8)	100	<0.0001
Dislocation	6,578	67	3,780 (57.5)	69	2,798 (42.5)	64	<0.0001
Muscle, tendon	4,298	44	1,929 (44.9)	35	2,369 (55.1)	54	<0.0001
Internal organ	1,129	11	377 (33.4)	7	752 (66.6)	17	<0.0001
Eye, orbit	732	7	449 (61.3)	8	283 (38.7)	6	NS

Note. Percentages were calculated by dividing count of each sex by total count of observations per injury type per sex. [a] Crude rate was calculated with total number of observations as the numerator, and the sum of Ontario's population over the five years as the denominator. [b] Sex-specific rates were calculated with total number of observations per sex as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. Rates were reported per 100,000 population. NS = Not Significant. TBI = Traumatic Brain Injury. A p value less than 0.05 was used as the level of Statistical Significance.

3.1.2.1 Fractures

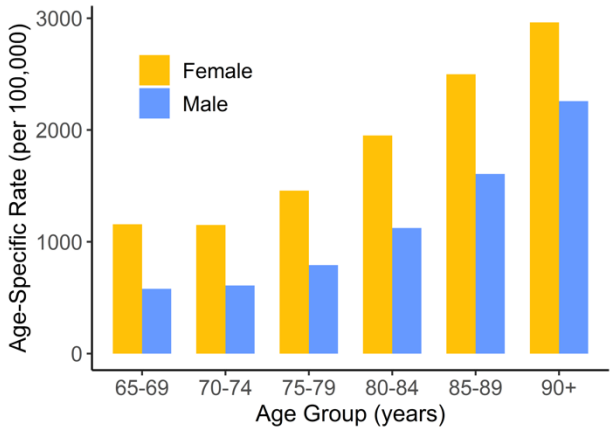
There were 121,687 observations with at least one fracture diagnosis, for a total of 131,035 fracture codes in patients at the ED, meaning there were observations with more than one fracture code. The mean age of patients with fractures was 77.6 (8.2) years; 78.0 (8.3) years in females and 77.0 (8.0) years in males. These mean ages were nearly identical to those among all FRI patients for both sexes at the ED. Chi-square tests revealed statistically significant sex differences in the number of patients with fracture diagnoses, with females experiencing more fractures than males, X^2 (1, N = 121,687) = 4898.2, $p < 0.001$ (Table 3-3). Age-standardized rates (1,237 per 100,000) were like the crude rate (Table 3-3). The most common chronic condition in patients with fractures was hypertension for both sexes (Appendix G, Tables G1-G3). The oldest age group (90+ years) experienced fractures 3.1 times more frequently than patients in the youngest group (65-69 years) and females experienced fractures at rates nearly double those of males. An age-related increase was seen in both sexes (Figure 3-2) and was greater in males. In the youngest group, the age-specific rate in females was double that of males, while in the oldest group, female rates were 31.2% higher than males. Tables I3 and I4 (Appendix I) include the counts and age-specific rates of males and females for all fractures.

Table 3-4
Patients with Fall-Related Fractures by Body Location Seen in the Emergency Department by Sex (2010-2014)

Fracture Location	Total		Female		Male		p value
	N	Rate [a]	N (% [b])	Rate [c]	N (% [b])	Rate [c]	
Hip	26,369	267	18,453 (70.0)	337	7,916 (30.0)	181	<0.0001
Forearm	24,180	245	19,732 (81.6)	360	4,448 (18.4)	102	<0.0001
Humerus	13,236	134	10,301 (77.8)	188	2,935 (22.2)	67	<0.0001
Rib	10,668	108	4,547 (42.6)	83	6,121 (57.4)	140	<0.0001
Wrist, hand	9,420	96	6,418 (68.1)	117	3,002 (31.9)	69	<0.0001
Knee, lower leg	7,822	79	5,547 (70.9)	101	2,275 (29.1)	52	<0.0001
Ankle	6,507	66	4,740 (72.8)	86	1,767 (27.2)	40	<0.0001
Foot	5,880	60	4,509 (76.7)	84	1,371 (23.3)	31	<0.0001
Vertebral	5,590	57	3,418 (61.1)	62	2,172 (38.9)	50	0.003
Skull, facial	5,003	51	3,002 (60.0)	55	2,001 (40.0)	46	<0.0001
Pelvis	4,806	49	3,715 (77.3)	68	1,091 (22.7)	25	<0.0001
Femur	2,684	27	2,071 (77.2)	38	613 (22.8)	14	<0.0001
Clavicle	2,223	23	1,331 (59.9)	24	892 (40.1)	20	0.002
Scapula	702	7	373 (53.1)	7	329 (46.9)	8	<0.0001

Note. [a] Crude rate was calculated with the total number observations as the numerator, and the sum of Ontario's population over the five years as the denominator. [b] Percent calculated using the total number of observations with fractures as the denominator. [c] Sex-specific rates were calculated with total number of observations per sex as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. Rates were reported per 100,000 population. A p value of 0.05 or less is considered statistically significant.

Figure 3-2
Patients with Fall-Related Fracture Diagnoses Seen in the Emergency Department by Age Group and Sex (2010-2014)

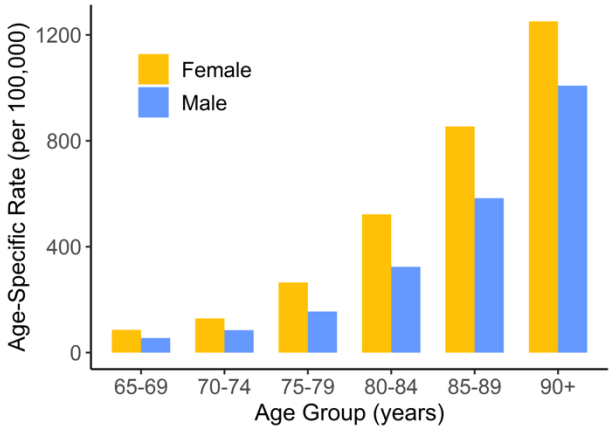


Note. Age-specific rates were calculated with total number of observations per sex and age group as the numerator, and the sum of Ontario's population over the five years per sex and age group as the denominator.

What parts of the body were most frequently fractured? Overall, limbs were more frequently fractured (978 per 100,000) than the trunk, neck, or head, with females experiencing 74.0% of all limb fractures. All fracture locations were more common in females than males except for rib and scapula fractures (Table 3-4).

Hip fractures were the most common fracture type and they accounted for 8.7% of all ED admissions and 21.8% of all fracture observations. The sex-specific rates were higher in females than males and females were slightly older (82.6±7.3 years) than males (81.1± 7.5 years). The age-specific rate of hip fractures (Figure 3-4) increased with age and was 16.7 times higher in the oldest group (1,184 per 100,000) than the youngest (71 per 100,000). More detail on demographic characteristics of patients with hip fractures is provided in Tables I3-I5 (Appendix I). Details on comorbidities in patients with hip fractures can be found in Tables G1, G2, and G4 (Appendix G).

Figure 3-3
Patients with Fall-Related Hip Fractures Seen in the Emergency Department by Age Group and Sex (2010-2014)

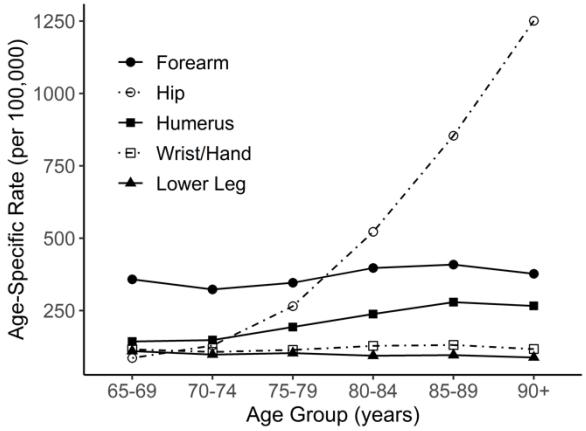


Note. Age-specific rates were calculated with total number of observations per sex and age group as the numerator and the sum of Ontario's population over the five years per sex and age group as the denominator.

The most common fracture types varied by age group and sex. Figure 3-4 shows the age-specific rates for common fracture locations in females. Overall, the most common fracture locations among females were the (1) forearm, (2) hip, (3) humerus, (4) wrist and hand, and (5) knee and lower leg (Table 3-4, Figure 3-4). Rates of hip fractures in females rose tremendously after age 80, surpassing rates of forearm, humerus, lower leg, and wrist and hand fractures. Fractures of the forearm, humerus, lower leg and knee, and wrist and hand did not change greatly across the age groups. In males, the sex-specific rates were highest in fractures of the (1) hip, (2) rib, (3) forearm, (4) wrist and

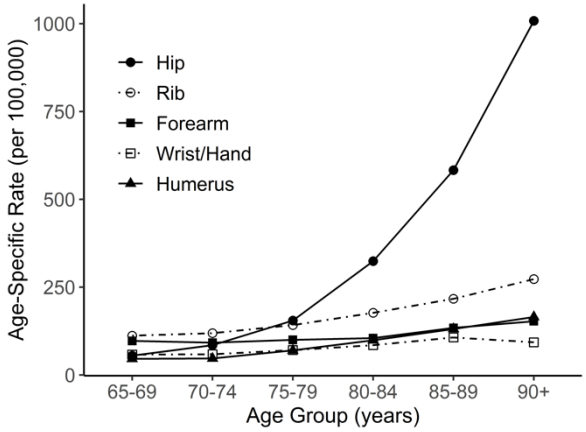
hand, and (5) humerus (Table 3-4; Figure 3-5). All fracture locations were examined by age group and sex and reported in Tables I3-I5 (Appendix I).

Figure 3-4
The Five most Common Fall-Related Fracture Locations in Females Seen in the Emergency Department (2010-2014)



Note. Age-specific rates were calculated with the total number of observations per age group as the numerator, and the sum of Ontario's population over the five years per age group as the denominator.

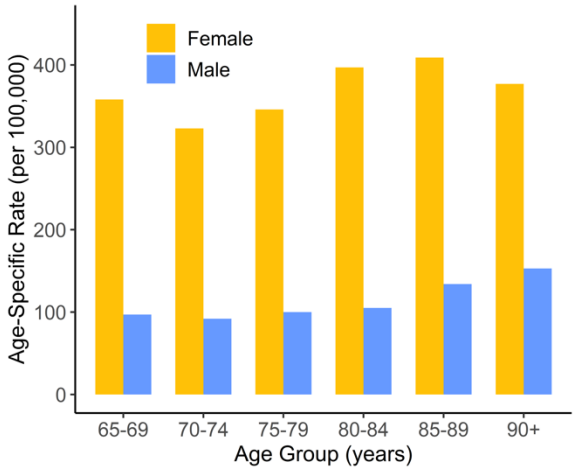
Figure 3-5
The Five most Common Fall-Related Fracture Locations in Males Seen in the Emergency Department (2010-2014)



Note. Age-specific rates were calculated with total number of observations per age group as the numerator, and the sum of Ontario's population over the five years per age group as the denominator.

Forearm fractures, humerus fractures, and fractures of the wrist and hand occurred more frequently in females than males (Table 3-4) and increased with advancing age in both sexes; however, there were differences in how these increases presented. There was no clear change in the rate of forearm fractures with advancing age groups in either sex (Figure 3-6); however, the rate was 3.5 times higher in females than males overall (Table 3-4). Humerus fracture rate increased 2.5 times from the youngest to oldest groups overall (Appendix I, Tables I3-I5). In females, the rate of humerus fractures only decreased from the age 85-89 to the age group 90+ years (Figure 3-7). Wrist and hand fractures did not show a steady age-related change in either sex, although Figure 3-8 shows that the age-specific rate increased more rapidly with age in males than females. Another important finding was that unlike the other fracture types, rib fractures were more common among males than females (Table 3-4) for all age groups, though rates increased with age in both sexes (Figure 3-9).

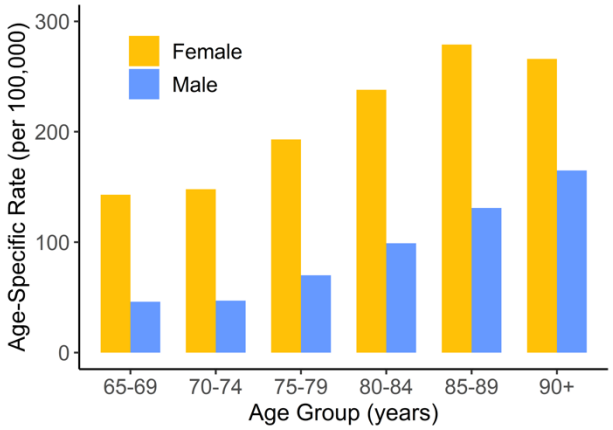
Figure 3-6
Patients with Fall-Related Forearm Fractures Seen in the Emergency Department by Age Group and Sex (2010-2014)



Note. Age-specific rates were calculated with total number of observations per sex and age group as the numerator, and the sum of Ontario's population over the five years per sex and age group as the denominator.

Figure 3-7

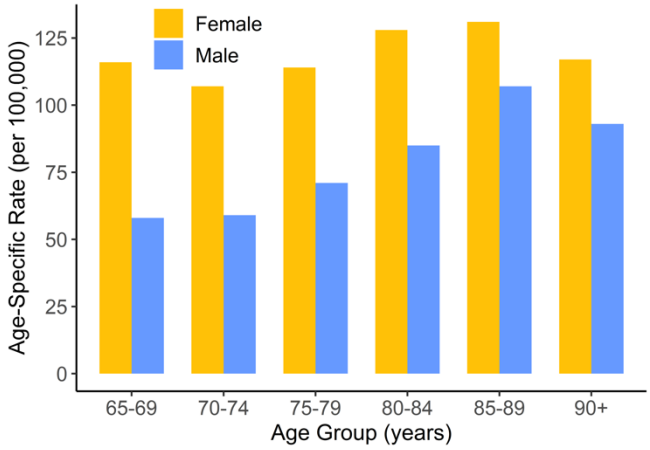
Patients with Fall-Related Humerus Fractures Seen in the Emergency Department by Age Group and Sex (2010-2014)



Note. Age-specific rates were calculated with total number of observations per sex and age group as the numerator, and the sum of Ontario's population over the five years per sex and age group as the denominator.

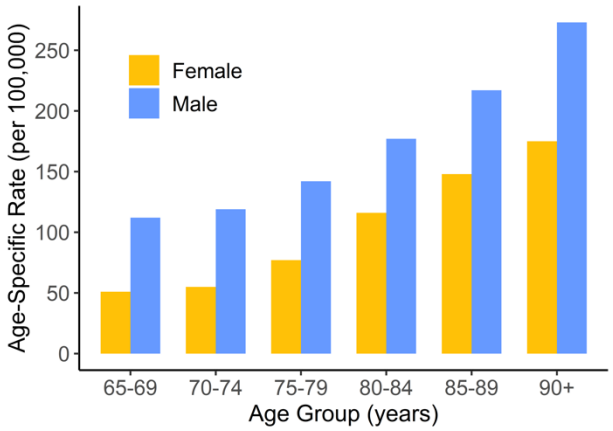
Figure 3-8

Patients with Fall-Related Wrist and Hand Fractures Seen in the Emergency Department by Age Group and Sex (2010-2014)



Note. Age-specific rates were calculated with total number of observations per sex and age group as the numerator and the sum of Ontario's population over the five years per sex and age group as the denominator.

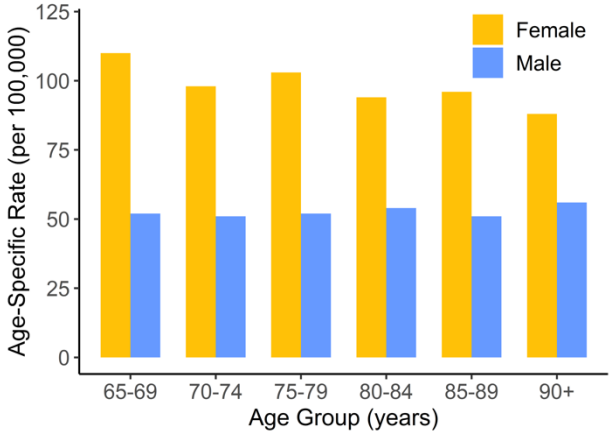
Figure 3-9
Patients with Fall-Related Rib Fractures Seen in the Emergency Department by Age Group and Sex (2010-2014)



Note. Age-specific rates were calculated with total number of observations per sex and age group as the numerator and the sum of Ontario's population over the five years per sex and age group as the denominator.

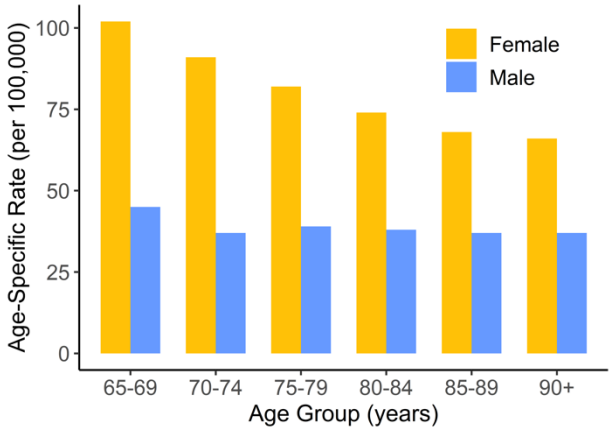
Fractures of the lower limb were seen in more female patients than male (Table 3-4). Knee and lower leg fractures did not fluctuate greatly with age group in either sex (Figure 3-10), while rates of ankle fractures and foot fractures decreased with advancing age. These decreases were more prominent among females than males (Figures 3-11 and 3-12).

Figure 3-10
Patients with Fall-Related Knee and Lower Leg Fractures Seen in the Emergency Department by Age Group and Sex (2010-2014)



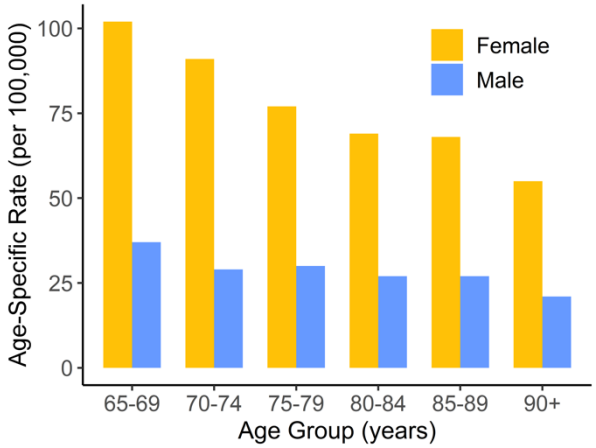
Note. Age-specific rates were calculated with total number of observations per sex and age group as the numerator and the sum of Ontario's population over the five years per sex and age group as the denominator.

Figure 3-11
Patients with Fall-Related Ankle Fractures Seen in the Emergency Department by Age Group and Sex (2010-2014)



Note. Age-specific rates were calculated with total number of observations per sex and age group as the numerator, and the sum of Ontario's population over the five years per sex and age group as the denominator.

Figure 3-12
Patients with Fall-Related Foot Fractures Seen in the Emergency Department by Age Group and Sex (2010-2014)

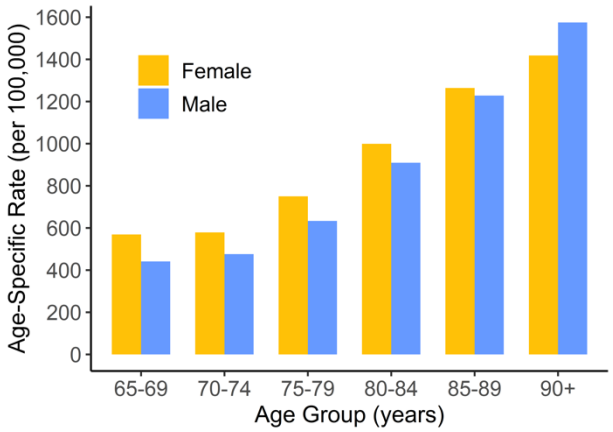


Note. Age-specific rates were calculated with total number of observations per sex and age group as the numerator, and the sum of Ontario's population over the five years per sex and age group as the denominator.

3.1.2.2 Superficial Injuries

Superficial injuries were the second most common injury type seen at the ED in both sexes (Table 3-3). Overall, rates increased with advancing age for both sexes and were higher in females for all age groups except the oldest (Figure 3-13). Most patients with superficial injuries (85.5%) did not have any other injury diagnosis code (N = 60,576; 614 per 100,000).

Figure 3-13
Patients with Fall-Related Superficial Injuries Seen in the Emergency Department by Age Group and Sex (2010-2014)

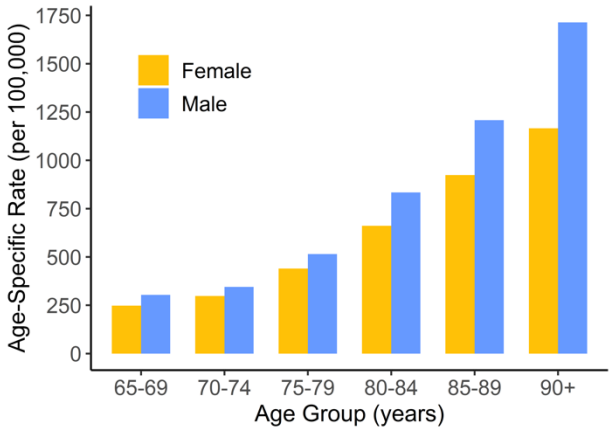


Note. Age-specific rates were calculated with total number of observations per sex and age group as the numerator, and the sum of Ontario's population over the five years per sex and age group as the denominator.

3.1.2.3 Open Wounds

Open wounds were another male-driven injury type. Age-specific rates were higher in males than in females (Table 3-3) for all age groups and increased with advancing age (Figure 3-14) with a more prominent increase among males. Open wounds most often occurred to the head (371 per 100,000), upper limbs (hand, arm, and shoulder; 97 per 100,000, combined), and lower limbs (foot, leg, and hip; 42 per 100,000). Open wounds of the head and upper limbs were higher in males for all age groups while the lower limb was more common in females of all ages (Table 3-5).

Figure 3-14
Patients with Fall-Related Open Wounds Seen in the Emergency Department by Age Group and Sex (2010-2014)



Note. Age-specific rates were calculated with total number of observations per sex and age group as the numerator, and the sum of Ontario's population over the five years per sex and age group as the denominator.

Table 3-5
Rates of Patients with Fall-Related Open Wounds by Body Locations Seen in the Emergency Department by Sex and Age Group (2010-2014)

Age group (years)	Head		Upper limb and shoulder		Lower limb and hip	
	Female	Male	Female	Male	Female	Male
65-69	190	230	32	54	27	25
70-74	230	259	42	66	30	23
75-79	335	385	68	109	45	32
80-84	499	610	108	205	70	42
85-89	689	860	171	340	95	58
90+	849	1,195	233	523	125	76

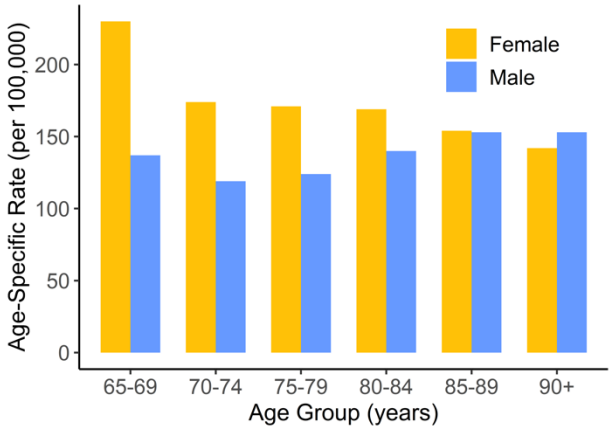
Note. Age-specific rates were calculated with total number of observations per sex and age group as the numerator, and the sum of Ontario's population over the five years per sex and age group as the denominator.

3.1.2.4 Sprains, Strains, Tears

The injury type category hereon referred to as 'sprains' included avulsions, cuts, lacerations, and traumatic ruptures of muscles, fascia, and tendons. Unlike other injury types, sprains became slightly less common with advancing age. Rates of sprains follow a unique pattern; in females the rate sharply decreased between 65-69 and 70-74 year age groups, but slowly declined thereafter while males had slight fluctuations throughout all age groups (Figure 3-15). The overall age-related decrease in rate appeared to be female-driven. Sprains are further described by body location. Sprains of the ankle and foot were most common (Table 3-6). Among females, rates of these injuries declined by half from

the youngest to oldest group while males decreased less dramatically (Figure 3-16). Counts and age-specific rates of all sprain locations are included in Table I6, by sex and age group (Appendix I).

Figure 3-15
Patients with Fall-Related Sprains, Strains, and Tears Seen in the Emergency Department by Sex and Age Group (2010-2014)



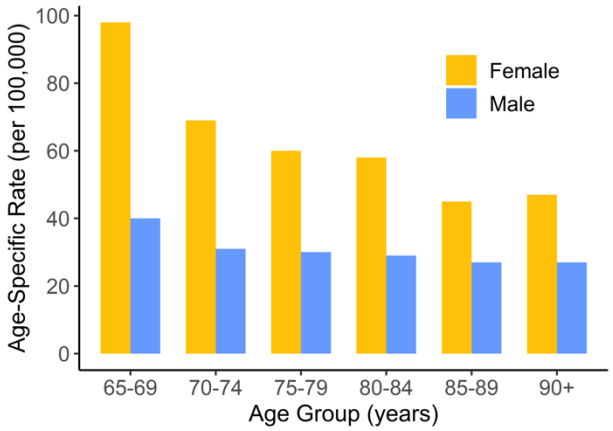
Note. Age-specific rates were calculated with total number of observations per sex and age group as the numerator, and the sum of Ontario's population over the five years per sex and age group as the denominator.

Table 3-6
Patients with Fall-Related Sprains, Strains, and Tears by Body Location Seen in the Emergency Department by Sex (2010-2014)

Body Location	Total		Female		Male	
	N (%)	Rate [a]	N (%)	Rate [b]	N (%)	Rate [b]
Ankle, foot	5,335 (33.5)	54	3,877 (38.2)	71	1,458 (25.3)	33
Knee, lower leg	2,850 (17.9)	29	1,730 (17.0)	32	1,120 (19.4)	26
Wrist, hand	2,797 (17.6)	28	1,817 (17.9)	33	980 (17.0)	22
Shoulder and upper arm	1,885 (11.8)	19	972 (9.6)	18	913 (15.8)	21
Trunk	1,567 (9.8)	13	907 (8.9)	14	660 (11.4)	12
Neck	945 (5.9)	10	527 (5.2)	10	418 (7.2)	10

Note. Sprains, strains, or tears of the neck include whiplash. [a] Crude rates were calculated with total number of sprain, strain, or tear observations per body location as the numerator and the sum of Ontario's population over the five years as the denominator. [b] Sex-specific rates were calculated with total number of sprain, strain, or tear observations per body location and sex as the numerator and the sum of Ontario's population over the five years per sex as the denominator. Rates were reported per 100,000 population. Denominator for percentage is the total of individuals diagnosed with a sprain, strain, or tear per sex.

Figure 3-16
Patients with Fall-Related Sprains, Strains, and Tears of the Ankle and Foot Seen in the Emergency Department by Age Group and Sex (2010-2014)

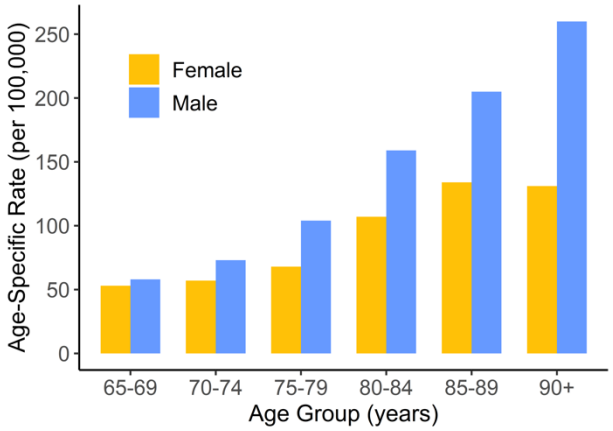


Note. Age-specific rates were calculated with total number of observations per sex and age group as the numerator, and the sum of Ontario's population over the five years per sex and age group as the denominator.

3.1.2.5 Traumatic Brain Injury

TBI diagnoses were more common in males than females (Table 3-3). Age-standardized rate (88 per 100,000) and crude rate (87 per 100,000) of TBI were nearly identical. Figure 3-18 shows that age-specific rates of patients with TBI increased with advancing age in both sexes and were consistently higher for males. Intracranial haemorrhages were the most common type of TBI (Table 3-7).

Figure 3-17
Patients with Fall-Related Traumatic Brain Injuries Seen in the Emergency Department by Age Group and Sex (2010-2014)



Note. Age-specific rates were calculated with total number of observations per sex and age group as the numerator, and the sum of Ontario's population over the five years per sex and age group as the denominator.

Table 3-7
Patients with Four Types of Fall-Related Traumatic Brain Injuries Seen in the Emergency Department (2010-2014)

Type of TBI	Total		Female		Male	
	N (% [a])	Rate [b]	N (%)	Rate [c]	N (%)	Rate [c]
Hemorrhage	5,177 (60.2)	31	2,339 (55.3)	24	2,838 (65.0)	41
Concussion	2,700 (31.4)	27	1,565 (37.0)	29	1,135 (26.0)	26
Diffuse brain injury	365 (4.2)	4	174 (4.1)	3	191 (4.4)	4
Focal brain injury	270 (3.1)	3	121 (2.9)	2	149 (3.4)	3

Note. TBI = Traumatic Brain Injury. [a] Percent calculated with total number of patients with a specific TBI per sex as the denominator and N per fall type per sex as the numerator. [b] Crude rates were calculated with total number of observations in older adults as the numerator, and the sum of Ontario's population over the five years as the denominator. [c] Crude rates were calculated with total number of observations per sex in older adults as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. All rates were reported per 100,000 population.

3.1.3 Mortality

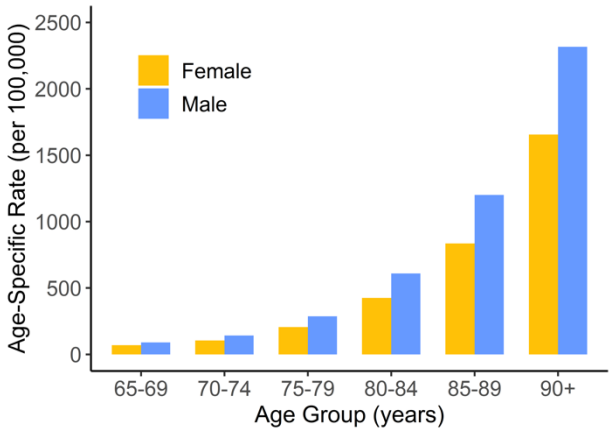
The mean age of patients who died within one year of an FRI event was 82.9±7.4 years; 83.8±7.2 in females and 81.9±7.4 years in males. Additionally, the rate of patients with FRIs who died within one year of ED visit was higher in males than females at all time intervals (Table 3-8). The rate of mortality within one year of FRI event increased with advancing age, nearly doubling with each five-year group (Figure 3-18). To gain further understanding of mortality after FRI events, mortality was examined separately in patients with all FRIs, fractures, hip fractures, open wounds, and TBI. For overall fractures (Table 3-9) and hip fractures (Table 3-10), rates of mortality within one year of FRI were higher in females than males, while rates were higher for males with open wounds (Table 3-11) and TBI (Table 3-12).

Table 3-8
Rates of Patients Who Died After Emergency Department Visit for All Fall-Related Injuries by Sex (2010-2014)

Time from ED admission to death	Total		Female		Male		p value
	N (% [a])	Rate	N (% [b])	Rate	N (% [b])	Rate	
Same day	254 (0.1)	3	118 (0.1)	2	136 (0.1)	3	<0.0001
One day	715 (0.2)	7	340 (0.2)	6	375 (0.3)	9	<0.0001
One week	3,235 (1.1)	33	1,683 (0.9)	31	1,552 (1.4)	35	<0.0001
One month	8,264 (2.7)	84	4,271 (2.2)	78	3,993 (3.5)	91	<0.0001
Six months	22,427 (7.4)	227	11,895 (6.2)	217	10,532 (9.4)	241	<0.0001
One year	33,054 (10.9)	335	17,752 (9.2)	324	15,302 (13.6)	350	<0.0001

Note. Percent is calculated with the total number of ED admissions per sex as the denominator. [a] Crude rates were calculated with total number of observations in older adults as the numerator, and the sum of Ontario's population over the five years as the denominator. [b] Sex-specific rates were calculated with total number of observations per sex in older adults as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. Rates were reported per 100,000 population. One month = 30 days. Six months = 183 days. One year = 365 days.

Figure 3-18
Rates of Patients who Died within One Year of Admission to Emergency Department for Any Fall-Related Injury by Sex (2010-2014)



Note. Crude rates were calculated with the Ontario population of older adults per age group as the denominator.

Table 3-9
Rates of Patients Who Died After Emergency Department Visit for All Fall-Related Fractures by Sex (2010-2014)

Time from ED admission to death	Total		Female		Male	
	N (%)	Rate	N (%)	Rate	N (%)	Rate
Same day	72 (0.1)	1	33 (0.0)	1	39 (0.1)	1
One day	243 (0.2)	2	124 (0.1)	2	119 (0.3)	3
One week	1,712 (1.4)	17	978 (1.1)	18	734 (2.0)	17
One month	4,261 (3.5)	43	2,433 (2.8)	44	1,828 (5.1)	42
Six months	10,119 (8.3)	103	6,045 (7.0)	110	4,074 (11.4)	93
One year	14,016 (11.5)	142	8,511 (9.9)	155	5,505 (15.4)	126

Note. Percent is calculated with the total number of patients with fractures at the ED per sex as the denominator. [a] Crude rates were calculated with total number of observations in older adults as the numerator, and the sum of Ontario's population over the five years as the denominator. [b] Sex-specific rates were calculated with total number of observations per sex in older adults as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. Rates were reported per 100,000 population. ED = Emergency Department. One month = 30 days. Six months = 183 days. One year = 365 days.

Table 3-10
Rates of Patients Who Died After Emergency Department Visit for Fall-Related Hip Fractures by Sex (2010-2014)

Time from ED admission to death	Total		Female		Male	
	N (%)	Rate	N (%)	Rate	N (%)	Rate
Same day	16 (0.1)	0	10 (0.1)	0	6 (0.1)	0
One day	98 (0.4)	1	61 (0.3)	1	37 (0.5)	1
One week	922 (3.5)	9	563 (3.1)	10	359 (4.5)	8
One month	2,315 (8.8)	23	1,337 (7.2)	24	978 (12.4)	22
Six months	3,854 (14.6)	51	2,984 (16.2)	54	2,014 (25.4)	46
One year	4,998 (24.3)	65	3,867 (21.0)	71	2,538 (32.1)	58

Note. Percent is calculated with the total number of patients with hip fractures at the ED per sex as the denominator. [a] Crude rates were calculated with total number of observations in older adults as the numerator, and the sum of Ontario's population over the five years as the denominator. [b] Sex-specific rates were calculated with total number of observations per sex in older adults as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. Rates were reported per 100,000 population. ED = Emergency Department. One month = 30 days. Six months = 183 days. One year = 365 days.

Table 3-11
Rates of Patients Who Died After Emergency Department Visit for Fall-Related Open Wounds by Sex (2010-2014)

Time from ED admission to death	Total		Female		Male	
	N (%)	Rate	N (%)	Rate	N (%)	Rate
Same day	40 (0.1)	0	21 (0.1)	0	19 (0.1)	0
One day	98 (0.2)	1	45 (0.2)	1	53 (0.2)	1
One week	371 (0.8)	4	165 (0.6)	3	206 (0.9)	5
One month	1,082 (2.2)	11	492 (1.9)	9	590 (2.6)	13
Six months	3,793 (7.7)	38	1,698 (6.5)	31	2,095 (9.1)	48
One year	6,013 (12.2)	61	2,712 (10.4)	49	3,301 (14.3)	75

Note. Percent is calculated with the total number of patients with open wounds at the ED per sex as the denominator. [a] Crude rates were calculated with total number of observations in older adults as the numerator, and the sum of Ontario's population over the five years as the denominator. [b] Sex-specific rates were calculated with total number of observations per sex in older adults as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. Rates were reported per 100,000 population. ED = Emergency Department. One month = 30 days. Six months = 183 days. One year = 365 days.

Table 3-12
Rates of Patients Who Died After Emergency Department Visit for Fall-Related Traumatic Brain Injuries by Sex (2010-2014)

Time from ED admission to death	Total		Female		Male	
	N (%)	Rate	N (%)	Rate	N (%)	Rate
Same day	127 (1.5)	1	53 (1.3)	1	74 (1.7)	2
One day	327 (3.8)	3	128 (3.0)	2	199 (4.6)	5
One week	772 (9.0)	8	336 (7.9)	6	436 (10.0)	10
One month	1,245 (14.5)	13	521 (12.3)	10	724 (16.6)	17
Six months	1,714 (19.9)	17	709 (16.8)	13	1,005 (23.0)	23
One year	1,985 (23.1)	20	841 (19.9)	15	1,144 (26.2)	26

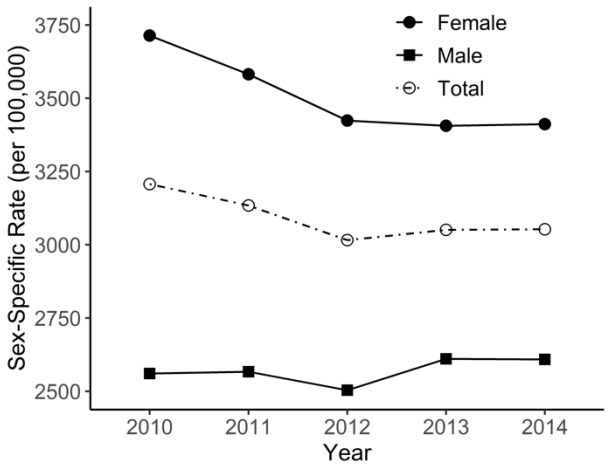
Note. Percent is calculated with the total number of patients with TBIs at the ED per sex as the denominator. [a] Crude rates were calculated with total number of observations in older adults as the numerator, and the sum of Ontario's population over the five years as the denominator. [b] Sex-specific rates were calculated with total number of observations per sex in older adults as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. Rates were reported per 100,000 population. ED = Emergency Department. One month = 30 days. Six months = 183 days. One year = 365 days.

3.1.4 Change Over Time

The number of ED admissions for an FRI increased by an average of 2.5% annually, with an overall increase of 10.2% and this increase was higher in males than females (Appendix I, Tables I7-I9). Despite the increase in number of FRIs, the annual crude rate declined by 4.8% overall. This decline was clearer in females than males (Figure 3-19). Age-standardized rates were similar to crude rates in all five years. The highest age-standardized rate occurred in 2010 (3,208 per 100,000) and the lowest in 2013 (3,021 per 100,000). Time-related change appeared to fluctuate by age group. Figure 3-20 shows that rates in the oldest age group decreased most notably with time. Annual counts and rates of injury types by sex can be found in Appendix I (Tables I10-I16).

Figure 3-19

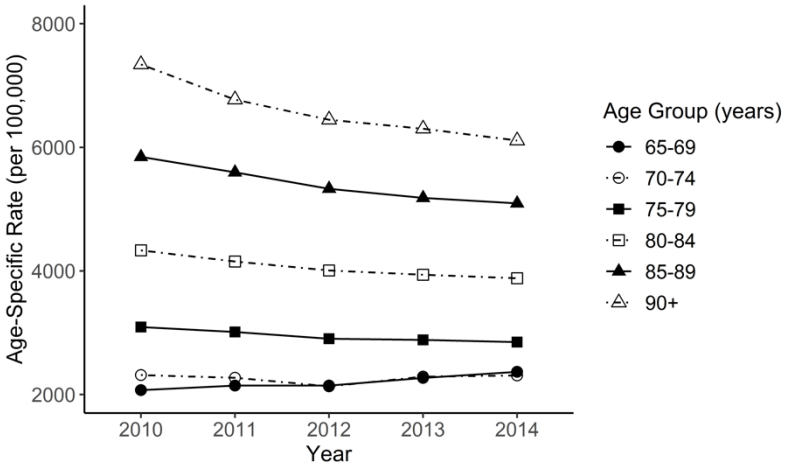
Change with Time in Rate of Patients with Fall-Related Injuries at the Emergency Department by Sex and Year



Note. Sex-specific rates were calculated with the Ontario population of older adults per sex and year as the denominator. Rates were reported per 100,000 population.

Figure 3-20

Change with Time in Rates of Patients with Fall-Related Injuries at the Emergency Department by Age-Group



Note. Age-specific rates were calculated with the Ontario population of older adults per age group and year as the denominator. Rates were reported per 100,000 population.

3.2 Hospital Level of Care

3.2.1 Demographics

From here on, study findings focus on FRIs that required hospital level of care. Nearly half (47.0%) of people who entered the ED for an FRI were subsequently hospitalized. Hospital admission percentages varied by sex and age group as well as injury and fall types, which are described in this section.

A greater proportion of males were hospitalized from the ED than females, and the proportion more than doubled from the youngest to oldest age groups (Table 3-13). Age-standardized rate of patients who were hospitalized after ED admission (1,452 per 100,000) was similar to crude and sex-specific rates; 1,459 per 100,000 (1,606 in females and 1,274 in males). The mean age of patients hospitalized for FRIs was 79.7 (8.0) years. The mean age was 80.3 (8.0) years in females and 78.8 (7.9) in males. Overall, the rate of hospitalizations increased 6.3 times from the youngest to oldest age groups (Table 3-13). This age-related increase was seen in both sexes and rates among females exceeded those of males for all age groups except 90+ years (Figure 3-21). Rates of hospitalizations varied by LHIN; Table 3-14 shows these rates for 2013. The South West LHIN had the lowest proportion of hospitalizations, while the North West LHIN had the highest (Table 3-13). Like ED admissions, rates of hospitalizations increased with higher income quintiles (Table 3-13). Information on chronic conditions for patients with various injury types admitted to the hospital for an FRI can be found in Appendix G, Table G5.

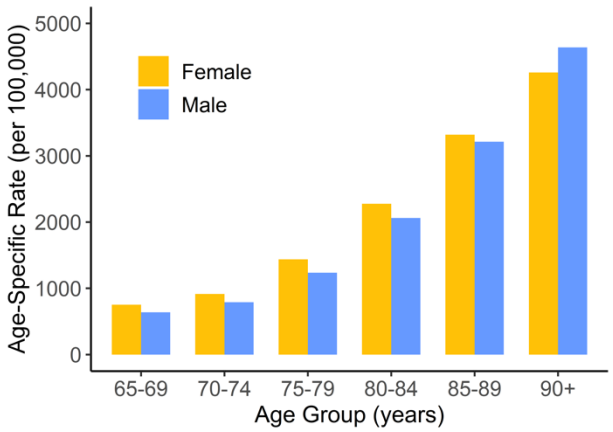
Table 3-13

Demographic Characteristics of Population of Older Adults with Fall-related Injuries Admitted to the Hospital by Count, Percent, and Rate (2010-2014)

Characteristic	N (% [a])	Rate (per 100,000)	Percent hospitalized [b]
Total [c]	143,210 (100)	1,452 [c]	47.0
Sex			
Female	87,613 (61.2)	1,598 [d]	45.6
Male	55,597 (38.3)	1,270 [d]	49.4
Age group (years) [e]			
65-69	21,434 (15.0)	698	31.6
70-74	19,672 (13.7)	857	37.9
75-79	24,388 (17.0)	1,346	45.7
80-84	30,179 (21.1)	2,187	53.4
85-89	28,062 (19.6)	3,281	60.8
90+	19,475 (13.6)	4,364	66.6
Chronic conditions [c, f]			
Asthma	23,176 (16.2)	235	50.6
COPD	46,338 (32.4)	470	57.2
Dementia	29,303 (20.5)	297	63.7
Diabetes	48,449 (33.8)	491	52.4
Hypertension	116,475 (81.3)	1,181	50.5
LHIN [c]			
1. Erie St. Clair	8,205 (5.7)	-	50.1
2. South West	12,809 (8.9)	-	47.9
3. Waterloo Wellington	7,093 (5.0)	-	47.5
4. Hamilton Niagara Haldimand Brant	19,102 (8.9)	-	49.4
5. Central West	5,664 (4.0)	-	46.4
6. Mississauga Halton	9,223 (6.4)	-	46.6
7. Toronto Central	11,282 (7.9)	-	46.4
8. Central	14,939 (10.4)	-	44.0
9. Central East	16,004 (11.2)	-	44.5
10. South East	7,016 (4.9)	-	43.4
11. Champlain	13,724 (9.6)	-	46.6
12. North Simcoe Muskoka	5,748 (4.0)	-	46.9
13. North East	8,871 (6.2)	-	51.9
14. North West	3,530 (2.5)	-	52.4
Nearest neighbourhood income quintile [c]			
1	31,551 (22.0)	320	50.1
2	29,868 (20.9)	303	47.2
3	27,825 (19.4)	282	46.9
4	27,030 (18.9)	274	45.8
5	26,366 (18.4)	267	44.7
NA	570 (0.4)	-	53.4
Deaths within days following hospitalization [c]			
Same day	147 (0.1)	1	57.9
One day	557 (0.4)	6	77.9
Three days	1,419 (1.0)	14	86.2
One week	2,880 (2.0)	29	89.0
One month [g]	7,460 (5.2)	76	90.3
Six months [h]	20,133 (14.1)	204	89.8
One year	29,536 (20.6)	300	89.4

Note. COPD = Chronic Obstructive Pulmonary Disease. [a] Denominator to calculate percentages = 143,210. [b] Denominator for percent hospitalized is the number of each characteristic hospitalized (Table 3-1). [c] Crude rates were calculated with total number of observations at the hospital as the numerator and the sum of Ontario's population over the five years as the denominator. [d] Sex-specific rates were calculated with total number of observations per sex as the numerator and the sum of Ontario's population over the five years per sex as the denominator. [e] Age-specific rates were calculated with total number of observations per age group as the numerator, and the sum of Ontario's population over the five years per age group as the denominator. [f] Percentages of comorbidities do not add to 100 as it is possible for patients to be diagnosed with more than one condition. [g] One month = 30 days. [h] Six months = 183 days.

Figure 3-21
Patients Admitted to the Hospital for all Fall-Related Injury Types by Sex and Age Group (2010-2014)



Note. Age-specific rates were calculated with total number of observations per sex and age group as the numerator, and the sum of Ontario's population over the five years per sex and age group as the denominator.

Table 3-14
Rates of Hospitalizations for Fall-Related Injuries by Local Health Integration Network for 2013

LHIN	N	Rate (per 100,000)
1. Erie St. Clair	1,660	1,637
2. South West	2,555	1,666
3. Waterloo Wellington	1,416	1,504
4. Hamilton Niagara Haldimond Brant	3,797	1,651
5. Central West	1,185	1,320
6. Mississauga Halton	1,891	1,423
7. Toronto Central	2,308	1,526
8. Central	3,043	1,347
9. Central East	3,321	1,480
10. South East	1,372	1,515
11. Champlain	2,785	1,586
12. North Simcoe Muskoka	1,128	1,521
13. North East	1,815	1,826
14. North West	688	1,944

Note. LHIN = Local Health Integration Network. Crude rates were calculated using the total number of hospital FRI observations per LHIN in the year 2013 as the numerator and the population of older adults per LHIN in 2013 as a denominator.

3.2.2 Injury Types

The most common injury types at the hospital varied slightly from those seen at the ED, with rates of TBI exceeding sprains (Table 3-15). A higher percentage of males were than females for all injury types except dislocations (Table 3-15). Tables J1 and J2 (Appendix J) display the rates and counts of patients with various injury types by sex and age group.

Table 3-15
Patients with Various Fall-Related Injury Types Admitted to the Hospital by Sex (2010-2014)

Injury type	Total		Female		Male		p value
	N (%)	Rate [a]	N (%)	Rate [b]	N (%)	Rate [b]	
Fracture	69,387 (57.0)	704	47,789 (55.7)	872	21,598 (60.3)	493	<0.0001
Superficial	27,848 (39.3)	282	16,026 (37.2)	292	11,822 (42.5)	270	<0.0001
With other injury	4,236 (41.1)	43	2,481 (38.4)	45	1,755 (45.5)	40	0.0004
Superficial only	23,612 (39.0)	239	13,545 (37.0)	247	10,067 (42.0)	230	<0.0001
Other, unspecified	24,148 (42.4)	245	13,764 (39.9)	251	10,384 (47.3)	237	<0.0001
Open wound	20,468 (41.6)	208	10,061 (38.6)	183	10,407 (45.1)	238	<0.0001
TBI	6,244 (72.6)	63	2,877 (68.0)	52	3,367 (77.2)	77	<0.0001
Sprain, strain, tear	4,329 (27.2)	44	2,555 (25.2)	47	1,774 (30.7)	41	0.003
Dislocation	2,265 (34.4)	23	1,343 (35.5)	24	922 (33.0)	21	NS
Muscle, tendon	1,432 (33.3)	15	604 (31.3)	11	828 (35.0)	19	<0.0001
Internal organ	926 (82.0)	9	314 (83.3)	6	612 (81.4)	14	<0.0001
Eye, orbit	341 (46.6)	3	195 (43.4)	4	146 (51.6)	3	NS

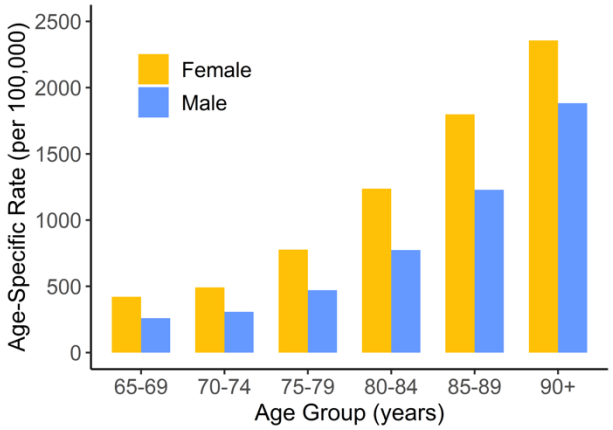
Note. Percentages were calculated by dividing count of each sex by total count of observations per injury type per sex. [a] Crude rate was calculated with total number of observations as the numerator, and the sum of Ontario's population over the five years as the denominator. [b] Sex-specific rates were calculated with total number of observations per sex as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. Rates were reported per 100,000 population. NS = Not Significant. TBI = Traumatic Brain Injury. A p value less than 0.05 was used as the level of Statistical Significance.

3.2.2.1 Fractures

Fractures were the most common injury type in patients admitted to the hospital. Age-standardized rate (overall, 706 per 100,000; 876 in females and 495 per 100,000 in males) was similar to crude and sex-specific rates of fractures (Table 3-15). Age-specific rate increased with advancing age in both sexes though rates were consistently higher in females than males (Figure 3-22). The percent of patients with fractures hospitalized from ED also increased with age and were higher in males (Figure 3-23). Table 3-16 displays the counts, rates, and percentages of patients with fracture by body location and sex. Findings on patients with five common chronic conditions are presented in Table G6 (Appendix G). Nearly all patients with hip fractures were hospitalized (98.7%). Overall, the age-standardized rate of hip fracture was 265 per 100,000; 334 in females and 179 in males. Compared to other common fracture locations, the age-specific rate of hip fractures increased most sharply with age (Figures 3-24 and 3-25).

Figure 3-22

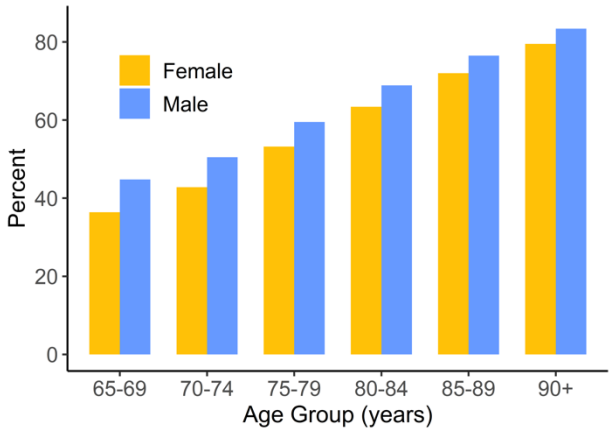
Patients with Fall-Related Fracture Diagnoses Admitted to the Hospital by Sex and Age Group (2010-2014)



Note. Age-specific rates are calculated with total number of observations per sex and age group as the numerator, and the sum of Ontario's population over the five years per sex and age group as the denominator.

Figure 3-23

Percent of Older Adults Hospitalized after Emergency Department Admission for Fall-Related Fracture (2010-2014)



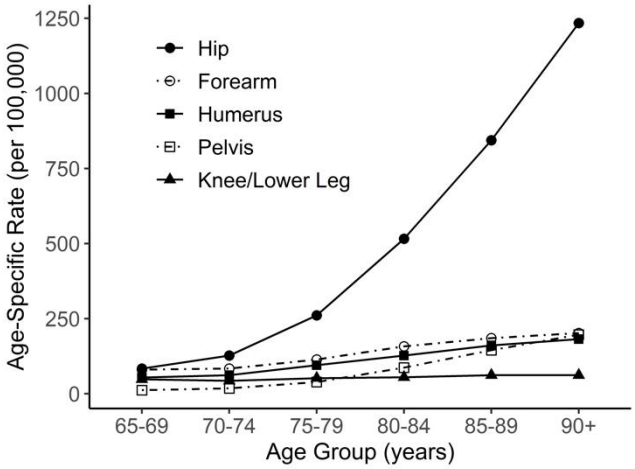
Note. Percent calculated with the total number of hospitalizations with fractures per sex and age group as the denominator and number of hospitalizations per sex and age group as numerator.

Table 3-16
Patients with Fall-Related Fractures Admitted to the Hospital by Sex (2010-2014)

Body location	Total		Female		Male	
	N (%)	Rate	N (%)	Rate	N (%)	Rate
Hip	26,020 (98.7)	264	18,211 (98.7)	332	7,809 (98.6)	178
Forearm	8,066 (33.4)	82	6,371 (32.3)	116	1,695 (38.1)	39
Humerus	6,735 (50.9)	68	5,052 (49.0)	92	1,683 (57.3)	38
Rib	5,076 (47.6)	51	2,168 (47.7)	40	2,908 (47.5)	66
Knee/lower leg	3,972 (50.8)	40	2,793 (50.4)	51	1,179 (51.8)	27
Pelvis	3,816 (79.4)	39	2,925 (78.7)	53	891 (81.7)	20
Vertebral	3,740 (66.9)	38	2,172 (63.5)	40	1,568 (72.2)	36
Ankle	3,682 (56.6)	37	2,700 (57.0)	49	982 (55.6)	22
Wrist/hand	2,759 (29.3)	28	1,811 (28.2)	33	948 (31.6)	22
Femur	2,575 (95.9)	26	1,993 (96.2)	36	582 (94.9)	13
Skull/facial	2,463 (49.2)	25	1,290 (43.0)	24	1,173 (58.6)	27
Foot	1,604 (27.3)	16	1,190 (26.4)	22	414 (30.2)	9
Clavicle	1,016 (45.7)	10	573 (43.1)	10	443 (49.7)	10
Scapula	333 (47.4)	3	165 (44.2)	3	168 (51.1)	4

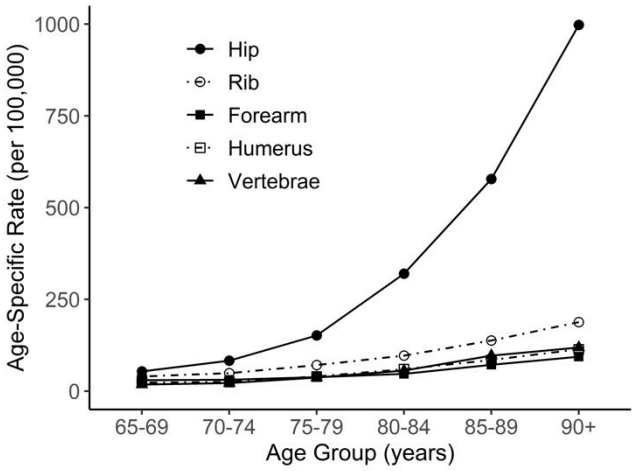
Note. Percent calculated with the total number of hospitalizations with each fracture location per sex as the denominator and number of hospitalizations for fracture location per sex as the numerator. [a] Crude rate was calculated with the total number observations as the numerator, and the sum of Ontario's population over the five years as the denominator. [b] Sex-specific rates were calculated with total number of observations for fracture type per sex as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. Rates were reported per 100,000 population.

Figure 3-24
Female Patients with Five Common Fall-Related Fractures Admitted to the Hospital (2010-2014)



Note. Age-specific rates were calculated with total number of observations per age group as the numerator, and the sum of Ontario's population over the five years per age group as the denominator.

Figure 3-25
Male Patients with Five Common Fall-Related Fractures Admitted to the Hospital (2010-2014)



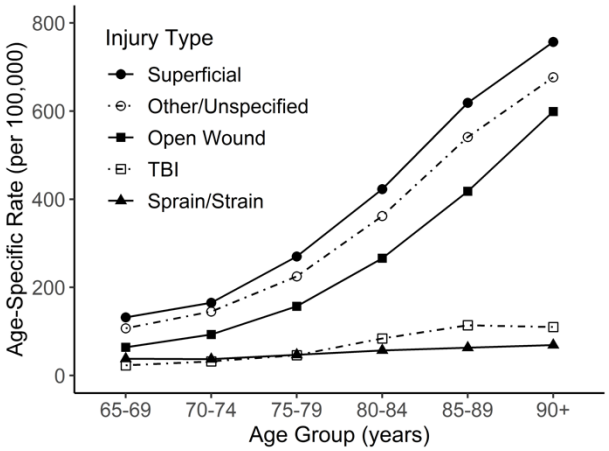
Note. Age-specific rates were calculated with total number of observations per age group as the numerator, and the sum of Ontario's population over the five years per age group as the denominator.

3.2.2.2 Non-Fracture Injuries

Figures 3-26 and 3-27 show the age- and sex-specific rates of superficial injuries, other or unspecified injuries, open wounds, TBI, and 'sprains, strains, and tears'. Superficial injuries were the second most prevalent injury after fractures. Most of these patients (84.8%) did not have any other injury diagnosis. Rates of superficial injuries, 'other and unspecified injuries' and open wounds increased with advancing age in both sexes, while the increase in TBI and sprains was more subtle (Figures 3-26 and 3-27). Open wounds of the head were seen in 74.5% (N = 15,239) of all patients with any open wound. Rates of head wounds were higher in males for all ages though the rate increased with advancing age in both sexes (Figure 3-28).

Figure 3-26

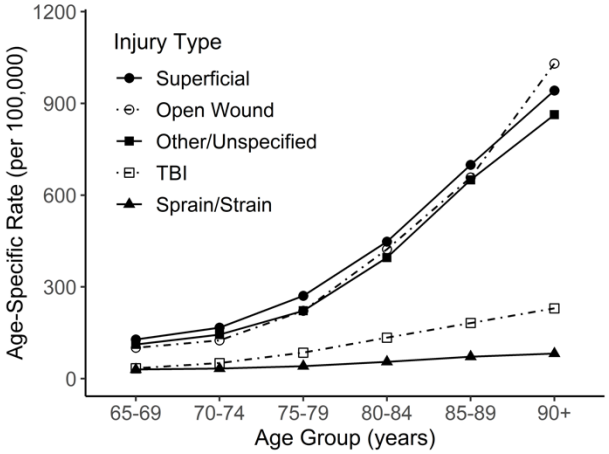
Female Patients with Common Fall-Related Injury Types Admitted to the Hospital by Age Group (2010-2014)



Note. Age-specific rates were calculated with total number of female observations per injury type and age group as the numerator, and the sum of Ontario's female population over the five years per age group as the denominator.

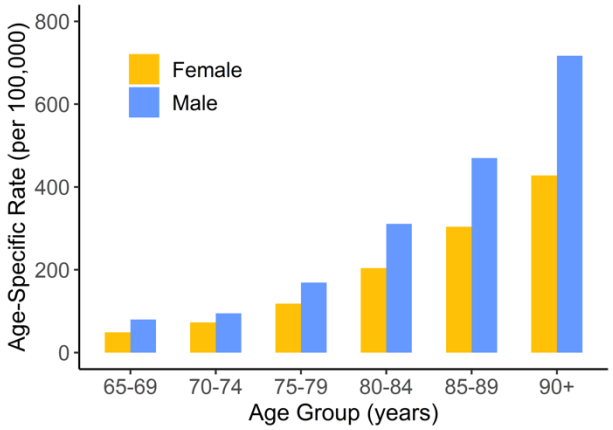
Figure 3-27

Male Patients with Common Fall-Related Injury Types Admitted to the Hospital by Age Group (2010-2014)



Note. Age-specific rates were calculated with total number of male observations per injury type and age group as the numerator, and the sum of Ontario's male population over the five years per age group as the denominator.

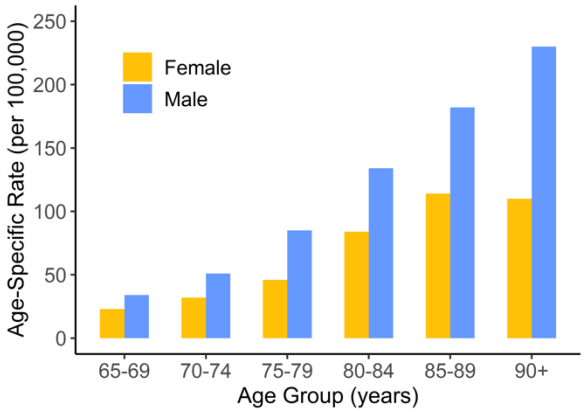
Figure 3-28
Patients with Fall-Related Open Wounds of the Head Admitted to the Hospital by Sex and Age Group (2010-2014)



Note. Age-specific rates were calculated with total number of observations per age group and sex as the numerator, and the sum of Ontario's population over the five years per age group and sex as the denominator.

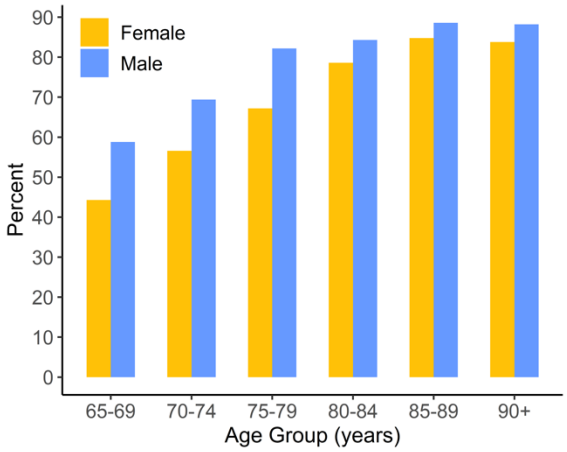
TBIs were most frequent in older males; age-specific rates increased with advancing age in both sexes, but this increase was sharper in males, with a rate more than double that of females in the 90+ year group (Figure 3-29). The percent of patients with TBI who were subsequently hospitalized after ED admission also increased with advancing age (Figure 3-30). Intracranial haemorrhage was the most common TBI (75.8%, 48 per 100,000), followed by concussion (14.7%, 10 per 100,000).

Figure 3-29
Patients with Fall-Related Traumatic Brain Injuries Admitted to the Hospital by Sex and Age Group (2010-2014)



Note. Age-specific rates were calculated with total number of observations per age group and sex as the numerator, and the sum of Ontario's population over the five years per age group and sex as the denominator.

Figure 3-30
Percentage of Patients with Fall-Related Traumatic Brain Injuries who were Hospitalized after Emergency Department Admission (2010-2014)



Note. Percentages were calculated with the number of TBIs at the ED per age group and sex as the denominator.

3.2.3 Mortality

In total, one-fifth (20.6%) of patients who were hospitalized for FRIs died within one year of the event date (Table 3-17). A higher rate of males at each time interval than females. Nearly one-fifth (19.9%) of all patients with any fracture died within one year, with a rate of 134 per 100,000. A quarter of patients (24.4%; 64 per 100,000) with hip fractures also died within a year, and this was higher in males (32.3%; 58 per 100,000) than females (21.0%; 70 per 100,000). TBI also appeared to be particularly problematic. A large portion of patients (29.8%) with TBIs died within one year of FRI event (31.8% of males and 27.4% of females).

Table 3-17
Rates of Patients Who Died After Hospitalization for All Fall-Related Injuries by Sex (2010-2014)

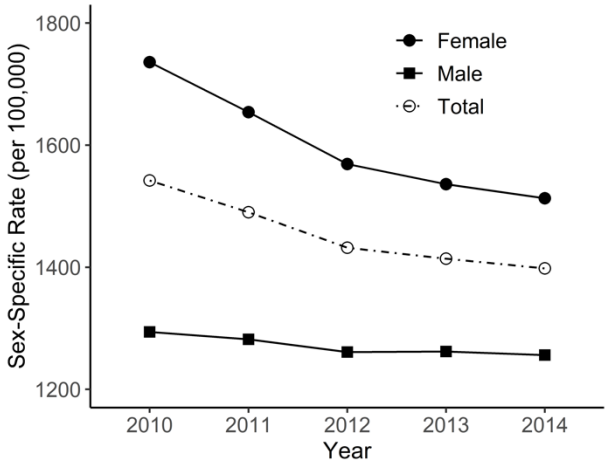
Time from FRI event to death	Total		Female		Male	
	N (% [a])	Rate	N (% [b])	Rate	N (% [b])	Rate
Same day	147 (0.1)	1	70 (0.1)	1	77 (0.1)	2
One day	557 (0.4)	6	266 (0.3)	5	291 (0.5)	7
One week	2,880 (2.0)	29	1,497 (1.7)	27	1,383 (2.5)	32
One month	7,460 (5.2)	76	3,820 (4.4)	70	3,640 (6.5)	83
Six months	20,133 (14.1)	204	10,564 (12.1)	193	9,569 (17.2)	219
One year	29,536 (20.6)	300	15,687 (17.9)	286	13,849 (24.9)	316

Note. Percent is calculated with the total number of hospitalizations per sex as the denominator. [a] Crude rates were calculated with total number of observations in older adults as the numerator, and the sum of Ontario's population over the five years as the denominator. [b] Sex-specific rates were calculated with total number of observations per sex in older adults as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. Rates were reported per 100,000 population. One month = 30 days. Six months = 183 days. One year = 365 days.

3.2.4 Change Over Time

Overall, the sex-specific rate decreased over the five-year period in females but remained stable in males (Figure 3-31). Tables J3, J4, and J5 (Appendix J) include the counts and rates of FRIs at the hospital per sex, age group, and year. The annual rate of FRIs at the hospital decreased in all age groups with time except for the youngest group (65-69 years) which increased. This pattern was observed in both sexes.

Figure 3-31
Change over Time in Rate of Patients with Fall-Related Injuries Admitted to the Hospital by Sex and Year



Note. Sex-specific rates were calculated with the Ontario population of older adults per sex and year as the denominator. Rates were reported per 100,000 population.

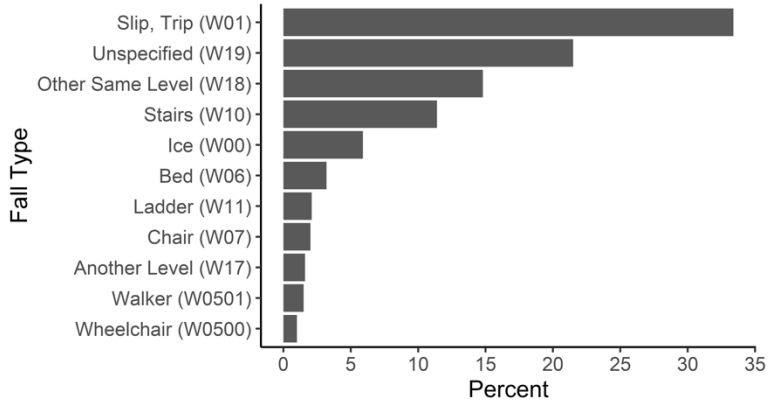
3.3 Types and Locations of Falls

In this section, the attention shifts from injuries to causes of the injuries – the falls. As before, results are presented first for ED, followed by hospitalizations. Different types of falls are reported overall and for major injury types (e.g. fracture, TBI, open wounds). The section concludes with a summary of findings.

3.3.1 Falls - Emergency Department Level of Care

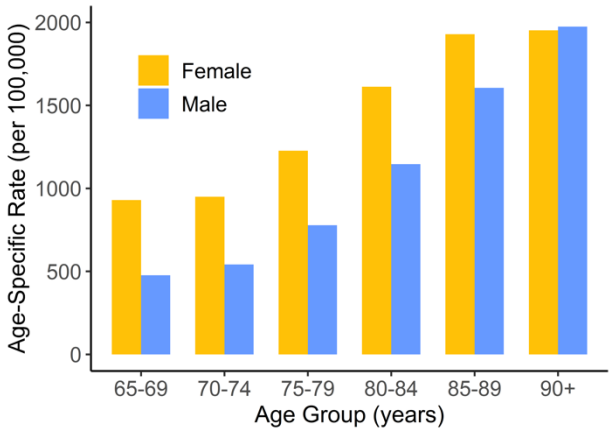
The types of falls that caused various injury types seen at the ED are described in this section. Counts and rates for fall types by age group and sex at the ED level can be found in Tables H1 and H2 (Appendix H). Figure 3-32 shows the percent of patients with codes for various fall types. The most common fall type was 'fall on same level from slipping, tripping, and stumbling' (W01) with a rate of 1,031 per 100,000. The sex-specific rate was higher in females than males for all age groups except the oldest group (Figure 3-33).

Figure 3-32
Patients with Codes for Various Fall Types Seen in the Emergency Department for all Fall-Related Injury Types (2010-2014)



Note. Denominator = 304,610. Slip, Trip = 'Fall on same level form slipping, tripping, and stumbling'. Other Same Level = 'Other fall on same level'. Stairs = 'Fall on and from stairs and steps'. Ice = 'Fall on same level involving ice and snow'. Bed = 'Fall involving bed'. Ladder = 'Fall on and from ladder'. Chair = 'Fall involving chair'. Another Level = 'Other fall from one level to another'. Walker = 'Fall involving adult walker'. Wheelchair = 'Fall involving wheelchair'.

Figure 3-33
Patients with Codes for 'Fall on Same Level from Slipping, Tripping, and Stumbling' (W01) Seen in the Emergency Department by Sex and Age Group (2010-2014)



Note. Age-specific rates were calculated with total number of observations per age group and sex as the numerator, and the sum of Ontario's population over the five years per age group and sex as the denominator.

The remaining fall types were also examined by age group and sex. The rate of patients with codes for 'unspecified fall' (W19) and 'other fall on same level' (W18) increased with advancing age and was overall higher in females than males (Figures 3-34 and 3-35). However, the rate of patients with a 'fall on and from stairs and steps' code followed a different pattern. In both sexes, the age-specific rate increased with age until the 85-89 group and decreased thereafter (Appendix H, Tables H1 and H2). This decrease was more prominent in females (Figure 3-36). "Diminishing rates among females drove led to an overall age-related decrease in the rate of 'fall on the same level involving ice and snow' (Figure 3-37).

So far, all fall types have been female-dominated; however, four fall types were predominantly seen in males. Codes for 'falls on and from ladder' were identified in 4.6% of all males (118 per 100,000) and only 0.7% of females (24 per 100,000) admitted to the ED. Less common fall types were more common in males than females; 'fall involving skates, skis, sport boards and in-line skates' (W02), 'fall from, out of or through building or structure' (W13), and 'fall from tree' (W14; Table 3-18). The types of falls that caused various injury types seen at the ED are described in this section. Counts and rates for fall types by age group and sex at the ED level can be found in Tables H1 and H2 (Appendix H). Figure 3-32 shows the percent of patients with codes

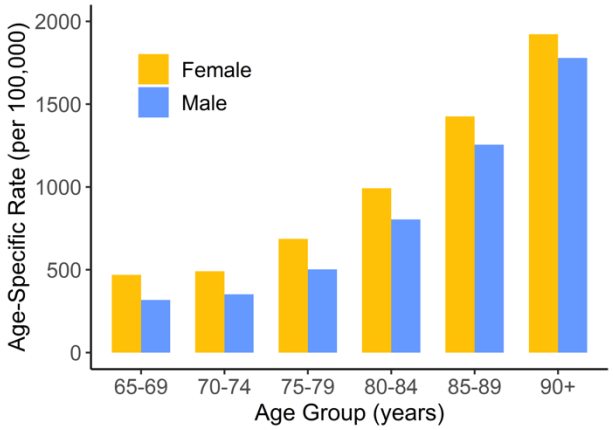
for various fall types. The most common fall type was ‘fall on same level from slipping, tripping, and stumbling’ (W01) with a rate of 1,031 per 100,000. The sex-specific rate was higher in females than males for all age groups except the oldest group (Figure 3-33).

Table 3-18
Patients with Codes for Various Fall Types Seen in the Emergency Department by Sex (2010-2014)

Fall type	Total		Female		Male	
	N (%)	Rate [a]	N (%)	Rate [b]	N (%)	Rate [b]
Slip, trip stumble	101,670 (33.4)	1,031	68,407 (35.6)	1,243	33,263 (29.5)	760
Unspecified	65,560 (21.5)	665	42,245 (22.0)	770	23,315 (20.7)	533
Other same level	45,009 (14.8)	456	28,689 (14.9)	523	16,320 (14.5)	373
Stairs, steps	34,828 (11.4)	353	22,473 (11.7)	410	12,355 (11.0)	282
Ice, snow	17,985 (5.9)	182	9,243 (4.8)	169	8,742 (7.8)	200
Bed	9,676 (3.2)	98	6,068 (3.2)	111	3,608 (3.2)	82
Ladder	6,436 (2.1)	65	1,289 (0.7)	24	5,147 (4.6)	118
Chair	5,945 (2.0)	60	3,828 (2.0)	70	2,117 (1.9)	48
One level to other	5,021 (1.6)	51	2,400 (1.2)	44	2,621 (2.3)	60
Walker	4,473 (1.5)	45	3,210 (1.7)	59	1,263 (1.1)	29
Wheelchair	3,048 (1.0)	31	1,724 (0.9)	31	1,324 (1.2)	30
Skates, sport boards	1,999 (0.7)	20	936 (0.5)	17	1,063 (0.9)	24
Other furniture	1,591 (0.5)	16	1,072 (0.6)	20	519 (0.5)	12
From building	652 (0.3)	7	133 (0.1)	2	519 (0.5)	12
Collision or pushing	338 (0.1)	3	255 (0.1)	3	83 (0.1)	2
From tree	152 (0.0)	2	7 (0.0)	0	145 (0.1)	3
Support from others	101 (0.0)	1	72 (0.0)	1	29 (0.0)	1

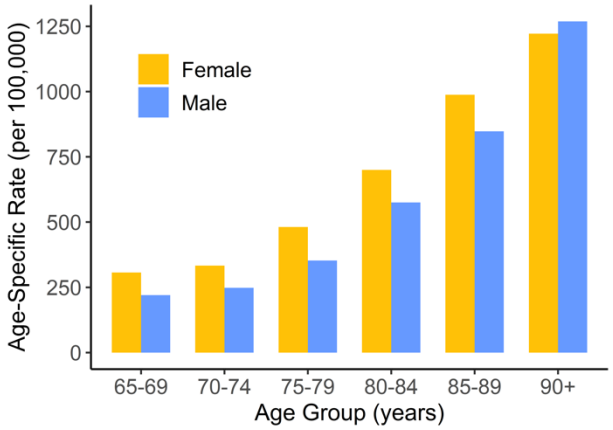
Note. Slip, trip, stumble = ‘Fall on same level from slipping, tripping, and stumbling’ (W01). Unspecified = ‘Unspecified fall’ (W19). Other same level = ‘Other fall on same level’ (W18). Stairs, steps = ‘Fall on and from stairs and steps’ (W10). Ice, snow = ‘Fall on same level involving ice and snow’ (W00). Bed = ‘Fall involving bed’ (W06). Ladder = Fall on and from ladder’ (W11). Chair = ‘Fall involving chair’ (W07). One level to other = ‘Other fall from one level to another’ (W17). Walker = ‘Fall involving adult walker’ (W0501). Wheelchair = ‘Fall involving wheelchair’ (W0500). Skates, sport boards = ‘fall involving skates, skis, sport boards, and in-line skates’ (W02). Other furniture = ‘fall involving other furniture’ (W08). From building = ‘fall from, out of or through building or structure’ (W13). Collision or pushing = ‘other fall on same level due to collision with, or pushing by, another person’ (W03). From tree = ‘Fall from tree’ (W14). Support from others = ‘fall while being carried or supported by other persons’ (W04). [a] Crude rates were calculated with the total number of observations per fall type as the numerator and the sum of Ontario’s population over the five-year period as the denominator. [b] Sex-specific rates were calculated with total number of observations per sex and fall type as the numerator, and the sum of Ontario’s population over the five years per sex as the denominator. Rates were reported per 100,000 population. Percent calculated with the total number of FRI observations per sex as the denominator.

Figure 3-34
Patients with Codes for 'Unspecified Fall' (W19) Seen in the Emergency Department by Sex and Age Group (2010-2014)



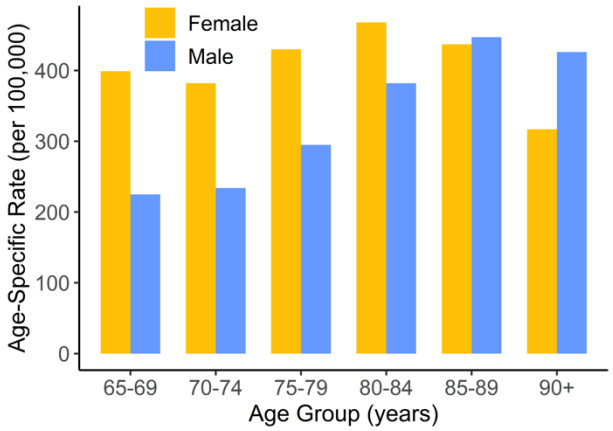
Note. Age-specific rates were calculated with total number of observations per age group and sex as the numerator, and the sum of Ontario's population over the five years per age group and sex as the denominator.

Figure 3-35
Patients with Codes for 'Other Fall on Same Level' (W18) Seen in the Emergency Department by Sex and Age Group (2010-2014)



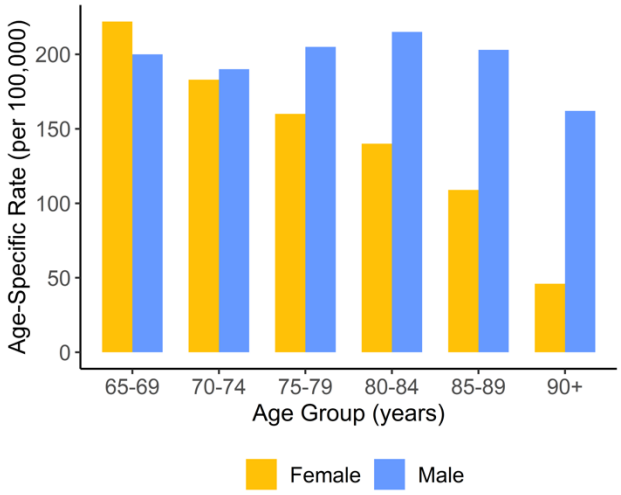
Note. Age-specific rates were calculated with total number of observations per age group and sex as the numerator, and the sum of Ontario's population over the five years per age group and sex as the denominator.

Figure 3-36
Patients with Codes for 'Fall on and from Stairs and Steps' (W10) Seen in the Emergency Department by Sex and Age Group (2010-2014)



Note. Age-specific rates were calculated with total number of observations per age group and sex as the numerator, and the sum of Ontario's population over the five years per age group and sex as the denominator.

Figure 3-37
Patients with Codes for 'Fall on Same Level Involving Ice and Snow'(W00) Seen in the Emergency Department by Sex and Age Group (2010-2014)



Note. Age-specific rates were calculated with total number of observations per age group and sex as the numerator, and the sum of Ontario's population over the five years per age group and sex as the denominator.

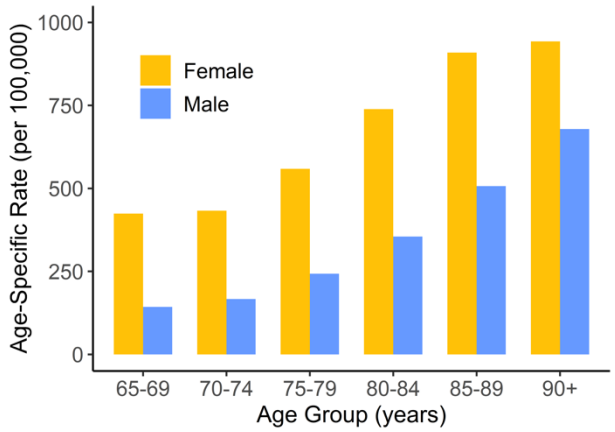
Now that types of falls have been reported, the focus switches to the location where FRI events typically occurred. Overall, there were 304,964 location codes in the NACRS dataset which indicates that there were individuals with multiple location codes. Unfortunately, 50.3% of all location codes were for 'unspecified place' (U989). Among

the remaining location codes, the most common location was the ‘home’ (U980; N = 85,792, 56.6%), followed by ‘residential institution’ (U98; N = 26,652, 17.6%) A greater proportion of females had a code for falls in residential institutions (19.2%) compared to males (14.6%).

3.3.1.1 Fractures

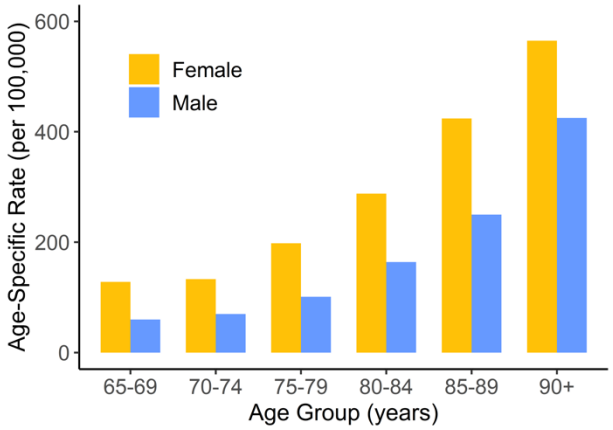
‘Fall on same level form slipping, tripping, and stumbling’ (W01) was the most common fall type in patients with fractures. Rates of patients with these falls increased with age in both sexes (Figure 3-38). Tables H3 and H4 (Appendix H) show the counts and rates of fall types seen in patients with fractures and are separated by sex and age group. ‘Unspecified fall’ was also increasingly common in older age groups (Figure 3-39, Tables H3 and H4 in Appendix H). ‘Other fall on same level’ (W18), and ‘fall on and from stairs and steps’ (W10) followed similar age- and sex-related patterns as all FRIs (Figures 3-40 and 3-41). Only half patients with fracture diagnoses (N = 62,805) contained information on a specific location of a fall and 58,882 patients had an ICD-10-CA code for an ‘unspecified place’. Of the observations with a specified injury location, 59.2% of patients with fractures experienced this event in the home (N = 37,187) and 17.4% in a residential institution (N = 10,954).

Figure 3-38
Patients with Fractures and Codes for ‘Fall on Same Level from Slipping, Tripping, and Stumbling’ (W01) Seen in the Emergency Department by Sex and Age Group (2010-2014)



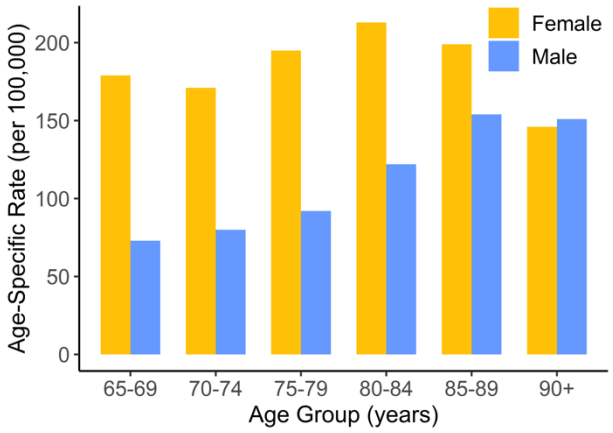
Note. Age-specific rates were calculated with total number of observations with fractures per age group and sex as the numerator, and the sum of Ontario’s population over the five years per age group and sex as the denominator.

Figure 3-39
Patients with Fractures and Codes for 'Other Fall on Same Level' (W18) Seen in the Emergency Department by Sex and Age Group (2010-2014)



Note. Age-specific rates were calculated with total number of observations with fractures per age group and sex as the numerator, and the sum of Ontario's population over the five years per age group and sex as the denominator.

Figure 3-40
Patients with Fractures and Codes for 'Fall on and from Stairs and Steps' (W10) Seen in the Emergency Department by Sex and Age Group (2010-2014)



Note. Age-specific rates were calculated with total number of observations with fractures per age group and sex as the numerator, and the sum of Ontario's population over the five years per age group and sex as the denominator.

There were 19,434 (73.7%) patients with hip fractures with a specified location of the injury event. The home was the most common location of fall (59.1% of patients with a specified location) followed by residential institutions (27.8%). A higher proportion of males than females had a code for an unspecified location (29.0% vs. 25.2%). The most

common fall types in patients with hip fractures are described in Table 3-19 and are further separated by age groups in Appendix H (Tables H5 and H6). Codes for 'fall on same level from slipping, tripping, and stumbling' were the most common in patients with fractures of the hip, hand and wrist, forearm, humerus, ankle, and foot fractures, followed by 'unspecified fall' (Tables 3-20 to 3-25). Details, including age group and sex, for the fall types seen with the above fractures can be found in Tables H7 to H9 (Appendix H).

Table 3-19
Types of Falls in Patients with Hip Fractures Seen in the Emergency Department by Sex (2010-2014)

Fall type	Total		Female		Male	
	N (%)	Rate [a]	N (%)	Rate [b]	N (%)	Rate [b]
Slip, trip, stumble	9,404 (35.7)	95	6,855 (37.1)	125	2,549 (32.2)	58
Unspecified	6,193 (23.5)	63	4,350 (23.6)	79	1,843 (23.5)	42
Other same level	4,690 (17.8)	48	3,344 (18.1)	61	1,346 (17.0)	31
Stairs, steps	1,674 (6.3)	17	1,154 (6.3)	21	520 (6.6)	12
Bed	1,030 (3.9)	10	712 (3.9)	13	318 (4.0)	7
Ice, snow	933 (3.5)	9	484 (2.6)	9	449 (5.7)	10
Walker	750 (2.9)	8	544 (2.6)	10	206 (2.8)	5
Chair	620 (2.4)	6	436 (2.3)	8	184 (2.4)	4
Wheelchair	341 (1.3)	3	201 (1.1)	4	140 (1.8)	3

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Stairs, steps = 'Fall on and from stairs and steps' (W10). Bed = 'Fall involving bed' (W06). Ice, snow = 'Fall on same level involving ice and snow' (W00). Walker = 'Fall involving adult walker' (W0501). Chair = 'Fall involving chair' (W07). Wheelchair = 'Fall involving wheelchair' (W0500). Percent was calculated with the number of patients per fall type per sex as the numerator and total number of patients with a hip fracture per sex as the denominator. [a] Crude rates were calculated with total number of observations per fall types as the numerator, and the sum of Ontario's population over the five years as the denominator. [b] Sex-specific rates were calculated with the total number of observations per fall types and sex as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. Rates were reported per 100,000 population.

Table 3-20
Types of Falls in Patients with Hand and Wrist Fractures Seen in the Emergency Department by Sex (2010-2014)

Fall type	Total		Female		Male	
	N (% [a])	Rate [b]	N (%)	Rate [c]	N (%)	Rate [c]
Slip, trip, stumble	3,687 (39.1)	37	2,664 (41.5)	49	1,023 (34.1)	23
Unspecified	2,258 (24.0)	23	1,524 (23.7)	28	734 (24.5)	17
Other same level	1,195 (12.7)	12	819 (12.8)	15	376 (12.5)	9
Stairs, steps	970 (10.3)	10	680 (10.6)	12	290 (9.7)	7
Ice, snow	586 (6.2)	6	339 (5.3)	6	247 (8.2)	6
Ladder	153 (1.6)	2	30 (0.5)	1	123 (4.1)	3
Bed	133 (1.4)	1	95 (1.5)	2	38 (1.3)	1
One level to other	118 (1.3)	1	72 (1.1)	1	46 (1.5)	4
Chair	110 (1.2)	1	75 (1.2)	1	35 (1.2)	1

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Stairs, steps = 'Fall on and from stairs and steps' (W10). Ice, snow = 'Fall on same level involving ice and snow' (W00). Ladder = 'Fall on and from ladder' (W11). Bed = 'Fall involving bed' (W06). One level to other = 'Other fall from one level to another' (W17). Chair = 'Fall involving chair' (W07). [a] Percent calculated with total number of patients with a wrist/hand fracture per sex as the denominator and N per fall type per sex as the numerator. [b] Crude rate was calculated with total number of observations as the numerator, and the sum of Ontario's population over the five years as the denominator. [c] Sex-specific rates were calculated with total number of observations per sex as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. All rates were reported per 100,000 population.

Table 3-21
Types of Falls in Patients with Forearm Fractures Seen in the Emergency Department by Sex (2010-2014)

Fall type	Total		Female		Male	
	N (%)	Rate [a]	N (%)	Rate [b]	N (%)	Rate [b]
Slip, trip, stumble	8,680 (35.9)	88	7,405 (37.5)	135	1,275 (28.7)	29
Unspecified	5,123 (21.2)	52	4,201 (21.3)	77	922 (20.7)	21
Other same level	3,142 (13.0)	32	2,636 (13.4)	48	506 (11.4)	12
Ice, snow	2,594 (10.7)	26	1,992 (10.1)	36	602 (13.5)	14
Stairs, steps	2,490 (10.3)	25	2,042 (10.3)	37	448 (10.1)	10
Ladder	497 (2.1)	5	334 (1.7)	3	163 (3.7)	8
Bed	324 (1.3)	3	283 (1.4)	5	41 (0.9)	1
One level to other	307 (1.3)	3	207 (1.0)	4	100 (2.2)	2
Skates, skis, sports boards	257 (1.1)	3	195 (1.0)	4	62 (1.4)	1

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Ice, snow = 'Fall on same level involving ice and snow' (W00). Stairs, steps = 'Fall on and from stairs and steps' (W10). Ladder = Fall on and from ladder' (W11). Bed = 'Fall involving bed' (W06). One level to other = 'Other fall from one level to another' (W17). Skates, sport boards = 'Fall involving skates, skis, sport boards, and in-line skates' (W02).[a] Percent calculated with total number of patients with a forearm fracture per sex as the denominator and N per fall type per sex as the numerator. [b] Crude rate was calculated with total number of observations as the numerator, and the sum of Ontario's population over the five years as the denominator. [c] Sex-specific rates were calculated with total number of observations per sex as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. All rates were reported per 100,000 population.

Table 3-22
Types of Falls in Patients with Humerus Fractures Seen in the Emergency Department by Sex (2010-2014)

Fall type	Total		Female		Male	
	N (% [a])	Rate [b]	N (%)	Rate [c]	N (%)	Rate [c]
Slip, trip, stumble	5,198 (39.3)	53	4,241 (41.2)	77	957 (32.6)	22
Unspecified	2,445 (18.5)	25	1,896 (18.4)	35	549 (18.7)	13
Other same level	1,648 (12.5)	17	1,299 (12.6)	24	349 (11.9)	8
Stairs, steps	1,506 (11.4)	15	1,179 (11.4)	22	327 (11.1)	7
Ice, snow	1,087 (8.2)	11	736 (7.1)	13	351 (12.0)	8
Bed	326 (2.5)	3	257 (2.5)	5	69 (2.4)	2

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Stairs, steps = 'Fall on and from stairs and steps' (W10). Ice, snow = 'Fall on same level involving ice and snow' (W00). Bed = 'Fall involving bed' (W06). [a] Percent calculated with total number of patients with a rib fracture per sex as the denominator and N per fall type per sex as the numerator. [b] Crude rate was calculated with total number of observations as the numerator, and the sum of Ontario's population over the five years as the denominator. [c] Sex-specific rates were calculated with total number of observations per sex as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. All rates were reported per 100,000 population.

Table 3-23
Types of Falls in Patients with Rib Fractures Seen in the Emergency Department by Sex (2010-2014)

Fall type	Total		Female		Male	
	N (% [a])	Rate [b]	N (%)	Rate [c]	N (%)	Rate [c]
Slip, trip, stumble	2,737 (25.7)	28	1,301 (28.6)	24	1,436 (23.5)	33
Unspecified	2,239 (21.0)	23	1,059 (23.3)	19	1,180 (19.3)	27
Other same level	1,597 (15.0)	16	795 (17.5)	14	802 (13.1)	18
Stairs, steps	1,563 (14.7)	16	689 (15.2)	13	874 (14.3)	20
Ice, snow	637 (6.0)	6	107 (2.4)	2	530 (8.7)	12
Ladder	565 (5.3)	6	44 (1.0)	1	521 (8.5)	12
Bed	353 (3.3)	4	205 (4.5)	4	148 (2.4)	3
One level to another	304 (2.8)	3	72 (1.6)	1	232 (3.8)	5
Chair	241 (2.3)	2	118 (2.6)	2	123 (2.0)	3

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Stairs, steps = 'Fall on and from stairs and steps' (W10). Ice, snow = 'Fall on same level involving ice and snow' (W00). Ladder = Fall on and from ladder' (W11). Bed = 'Fall involving bed' (W06). One level to other = 'Other fall from one level to another' (W17). Chair = 'Fall involving chair' (W07). [a] Percent calculated with total number of patients with a rib fracture per sex as the denominator and N per fall type per sex as the numerator. [b] Crude rate was calculated with total number of observations as the numerator, and the sum of Ontario's population over the five years as the denominator. [c] Sex-specific rates were calculated with total number of observations per sex as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. All rates were reported per 100,000 population.

Table 3-24
Types of Falls in Patients with Ankle Fractures Seen in the Emergency Department by Sex (2010-2014)

Fall type	Total		Female		Male	
	N (% [a])	Rate [b]	N (%)	Rate [c]	N (%)	Rate [c]
Slip, trip, stumble	2,050 (31.5)	21	1,695 (35.8)	31	355 (20.1)	8
Stairs, steps	1,301 (20.0)	13	1,032 (21.8)	19	269 (15.2)	6
Ice, snow	973 (15.0)	10	621 (13.1)	11	352 (19.9)	8
Unspecified	904 (13.9)	9	678 (14.3)	12	226 (12.8)	5
Other same level	577 (8.9)	6	430 (9.1)	8	147 (8.3)	3
Ladder	170 (2.6)	2	44 (0.9)	1	126 (7.1)	3
One level to other	145 (2.2)	1	89 (1.9)	2	56 (3.2)	1
Chair	74 (1.1)	1	62 (1.3)	1	12 (0.7)	0
Bed	70 (1.1)	1	59 (1.2)	1	11 (0.6)	0

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Stairs, steps = 'Fall on and from stairs and steps' (W10). Ice, snow = 'Fall on same level involving ice and snow' (W00). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Ladder = Fall on and from ladder' (W11). One level to other = 'Other fall from one level to another' (W17). Chair = 'Fall involving chair' (W07). Bed = 'Fall involving bed' (W06). [a] Percent calculated with total number of patients with an ankle fracture per sex as the denominator and N per fall type per sex as the numerator. [b] Crude rate was calculated with total number of observations as the numerator, and the sum of Ontario's population over the five years as the denominator. [c] Sex-specific rates were calculated with total number of observations per sex as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. All rates were reported per 100,000 population.

Table 3-25
Types of Falls in Patients with Foot Fractures Seen in the Emergency Department by Sex (2010-2014)

Fall type	Total		Female		Male	
	N (% [a])	Rate [b]	N (%)	Rate [c]	N (%)	Rate [c]
Slip, trip, stumble	2,050 (34.9)	21	1,695 (37.6)	31	355 (25.9)	8
Stairs, steps	1,432 (24.4)	15	1,142 (25.3)	21	290 (21.2)	7
Unspecified	1,023 (17.4)	10	823 (18.3)	15	200 (14.6)	5
Other same level	465 (7.9)	5	366 (8.1)	7	99 (7.2)	2
Ladder	309 (5.3)	3	57 (1.3)	1	252 (18.4)	6
One level to another	160 (2.7)	2	99 (2.2)	2	61 (4.4)	1
Chair	124 (2.1)	1	107 (2.4)	2	17 (1.2)	0
Bed	92 (1.6)	1	70 (1.6)	1	22 (1.6)	1
Ice, snow	84 (1.4)	1	57 (1.3)	1	27 (2.0)	1

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Stairs, steps = 'Fall on and from stairs and steps' (W10). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Ladder = Fall on and from ladder' (W11). One level to other = 'Other fall from one level to another' (W17). Chair = 'Fall involving chair' (W07). Bed = 'Fall involving bed' (W06). Ice, snow = 'Fall on same level involving ice and snow' (W00). [a] Percent calculated with total number of patients with an foot fracture per sex as the denominator and N per fall type per sex as the numerator. [b] Crude rate was calculated with total number of observations as the numerator, and the sum of Ontario's population over the five years as the denominator. [c] Sex-specific rates were calculated with total number of observations per sex as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. All rates were reported per 100,000 population.

3.3.1.2 Non-Fracture Injuries

Unlike other fracture types, 'unspecified fall' was recorded in the greatest number of patients with TBI, followed by 'fall on same level from slipping, tripping, and stumbling', 'fall on and from stairs and steps', and 'other fall on same level' (Table 3-25). There were 5,303 (61.7% of all patients with TBI) patients that had a code for a specified location of FRI event. Of these patients, 63.4% experienced a fall-related TBI at home, and 13.8% in residential institutions. Further information on fall types seen in patients with open wounds and sprains can be found in Tables 3-26, 3-27, and Tables H10 to H12 (Appendix H).

Table 3-26
Types of Falls in Patients with a Traumatic Brain Injury Seen in the Emergency Department by Sex (2010-2014)

Fall type	Total		Female		Male	
	N (% [a])	Rate [b]	N (%)	Rate [c]	N (%)	Rate [c]
Unspecified	2,463 (28.7)	25	1,221 (28.9)	22	1,242 (28.5)	28
Slip, trip, stumble	1,603 (18.7)	16	904 (21.4)	16	699 (16.0)	16
Stairs, steps	1,404 (16.3)	14	735 (17.4)	13	669 (15.3)	15
Other same level	1,403 (16.3)	14	691 (16.3)	13	712 (16.3)	16
Ice, snow	593 (6.9)	6	231 (5.5)	4	362 (8.3)	8
Ladder	274 (3.2)	3	38 (0.9)	1	236 (5.4)	5
Bed	233 (2.7)	2	132 (3.1)	2	101 (2.3)	2

Note. Unspecified = 'Unspecified fall' (W19). Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Stairs, steps = 'Fall on and from stairs and steps' (W10). Other same level = 'Other fall on same level' (W18). Ice, snow = 'Fall on same level involving ice and snow' (W00). Ladder = Fall on and from ladder' (W11). Bed = 'Fall involving bed' (W06). [a] Percent calculated with total number of patients with a TBI per sex as the denominator and N per fall type per sex as the numerator. [b] Crude rate was calculated with total number of observations as the numerator, and the sum of Ontario's population over the five years as the denominator. [c] Sex-specific rates were calculated with total number of observations per sex as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. All rates were reported per 100,000 population.

Table 3-27
Types of Falls in Patients with Open Wounds Seen in the Emergency Department by Sex (2010-2014)

Fall type	Total		Female		Male	
	N (% [a])	Rate [b]	N (%)	Rate [c]	N (%)	Rate [c]
Slip, trip, stumble	18,867 (38.4)	191	10,614 (40.7)	194	8,253 (35.8)	189
Unspecified	8,594 (17.5)	87	4,594 (17.6)	84	4,000 (17.3)	91
Other same level	7,912 (16.1)	80	4,162 (16.0)	76	3,750 (16.2)	86
Stairs, steps	5,350 (10.9)	54	2,998 (11.5)	55	2,352 (10.2)	54
Ice, snow	1,524 (3.1)	15	578 (2.2)	11	946 (3.1)	22
Bed	2,063 (4.2)	21	990 (3.8)	18	1,073 (4.6)	25
Chair	969 (2.0)	10	509 (2.0)	9	460 (2.0)	11
Ladder	951 (1.9)	10	130 (0.5)	2	821 (3.6)	19
Walker	787 (1.6)	8	515 (2.0)	9	272 (1.2)	6
Wheelchair	748 (1.5)	8	400 (1.5)	7	348 (1.5)	8

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Stairs, steps = 'Fall on and from stairs and steps' (W10). Ice, snow = 'Fall on same level involving ice and snow' (W00). Bed = 'Fall involving bed' (W06). Chair = 'Fall involving chair' (W07). Ladder = Fall on and from ladder' (W11). Walker = 'Fall involving adult walker' (W0501). Wheelchair = 'Fall involving wheelchair' (W0500). [a] Percent calculated with total number of patients with open wounds per sex as the denominator and N per fall type per sex as the numerator. [b] Crude rate was calculated with total number of observations as the numerator, and the sum of Ontario's population over the five years as the denominator. [c] Sex-specific rates were calculated with total number of observations per sex as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. All rates were reported per 100,000 population.

Table 3-28
Types of Falls in Patients with Sprains, Strains, and Tears Seen in the Emergency Department by Sex (2010-2014)

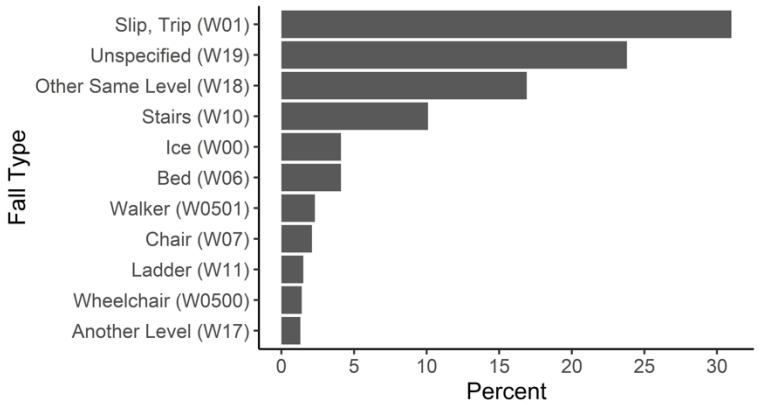
Fall type	Total		Female		Male	
	N (% [a])	Rate [b]	N (%)	Rate [c]	N (%)	Rate [c]
Slip, trip, stumble	5,352 (33.6)	54	3,611 (35.5)	66	1,741 (30.2)	40
Unspecified	3,143 (19.7)	32	2,066 (20.3)	38	1,077 (18.7)	25
Stairs, steps	2,567 (16.1)	26	1,796 (17.7)	33	771 (13.4)	18
Other same level	1,765 (11.1)	18	1,153 (11.4)	21	612 (10.6)	14
Ice, snow	1,270 (8.0)	13	607 (6.0)	11	663 (11.5)	15
One level to another	428 (2.7)	4	207 (2.0)	4	221 (3.8)	5
Ladder	380 (2.4)	4	84 (0.8)	2	296 (5.1)	7
Bed	321 (2.0)	3	205 (2.0)	4	116 (2.0)	3
Chair	264 (1.7)	3	184 (1.8)	3	80 (1.4)	2

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Stairs, steps = 'Fall on and from stairs and steps' (W10). Other same level = 'Other fall on same level' (W18). Ice, snow = 'Fall on same level involving ice and snow' (W00). One level to other = 'Other fall from one level to another' (W17). Ladder = Fall on and from ladder' (W11). Bed = 'Fall involving bed' (W06). Chair = 'Fall involving chair' (W07). [a] Percent calculated with total number of patients with open wounds per sex as the denominator and N per fall type per sex as the numerator. [b] Crude rate was calculated with total number of observations as the numerator, and the sum of Ontario's population over the five years as the denominator. [c] Sex-specific rates were calculated with total number of observations per sex as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. All rates were reported per 100,000 population.

3.3.2 Falls - Hospital Level of Care

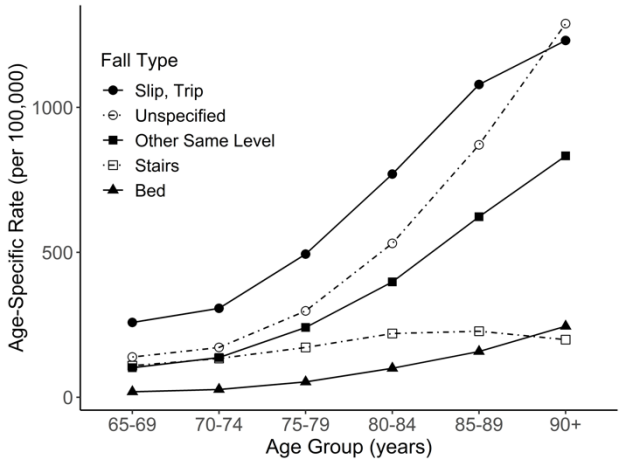
Similar to ED admissions, ‘fall on same level from slipping, tripping, and stumbling’ was the most common fall code seen in patients who were hospitalized, followed by ‘unspecified fall’. Figure 3-44 shows the percent of patients at the hospital level of care with codes for various fall types. The numbers and rates of fall types fluctuated by age group and sex (Appendix H, Tables H13 and H14). Figures 3-45 and 3-46 show the age-specific rates of the five most common fall types separately by sex and age groups. Overall, the rate for most fall types increased with advancing age apart from ‘fall on and from stairs and steps’ in both sexes and ‘fall on same level involving snow and ice’ in males. There were 84,854 observations with codes for location of falls and 58,421 (40.8%) were an ‘unspecified location’(U989). A greater proportion (59.3%) of older adults in hospital had a specified location of injury compared to patients in the ED. Of the individuals with a specified location of fall, the most common location was the home (60.3%) followed by residential institutions (21.5%).

Figure 3-41
Patients with Codes for Various Fall Types Admitted to the Hospital for all Fall-Related Injury Types, by Percent (2010-2014)



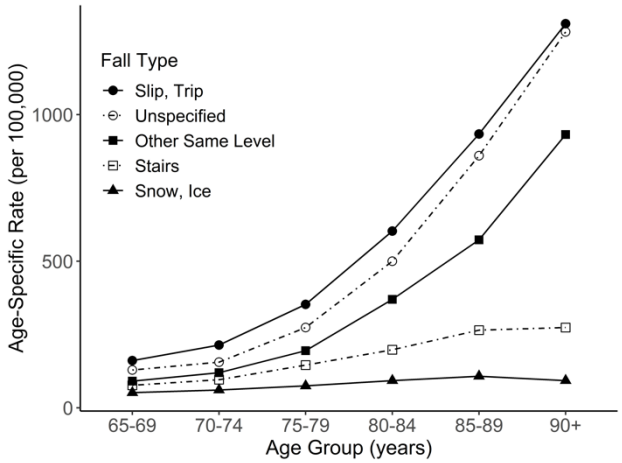
Note. Denominator = 143,210. Other = ICD-10-CA codes W02, W03, W04, W08, W09, W12, W13, W14, W15, W16.

Figure 3-42
Common Fall Types in Females with all Fall-Related Injuries Admitted to the Hospital (2010-2014)



Note. Slip, trip = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Stairs = 'Fall on and from stairs and steps' (W10). Bed = 'Fall involving bed' (W06). Age-specific rates are calculated with total number of female observations per age group and fall type as the numerator, and the sum of Ontario's population over the five years per age group as the denominator.

Figure 3-43
Common Fall Types in Males with all Fall-Related Injuries Admitted to the Hospital (2010-2014)



Note. Slip, Trip = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other Same Level ='Other fall on same level' (W18). Stairs = 'Fall on and from stairs and steps' (W10). Snow, Ice = 'Fall on same level involving ice and snow' (W00). Age-specific rates are calculated with total number of male observations per age group and fall type as the numerator, and the sum of Ontario's population over the five years per age group as the denominator.

3.4 Summary of Results

This chapter reported descriptive findings for two levels of healthcare; patients admitted to the ED for an FRI, and patients who were subsequently hospitalized. At both levels of care, fractures were the most common injury type, and the hip was the most common fracture location. In both care settings, the injury types (e.g., fractures and TBI) and body locations (e.g., hip and forearm fractures) varied by age group and sex. Generally, injury rates were higher in females and increased with advancing age groups. Fractures of the forearm, humerus, and wrist and hand were more common in the youngest age group (65-69 years) and did not increase as notably with advancing age. Hip fractures increased drastically, becoming the most common fracture type in the 80-84 year (female) and 75-79 year groups (male). There are more female older adults in Ontario than males, so it is not surprising that the proportion of females was greater than males in both the NACRS and DAD datasets. However, this does not explain why crude rates for TBIs, injuries of internal organs, injuries of muscles and tendons, and rib fractures were higher in males than females. More males died within one year of ED admission, and crude rate of mortality was higher in females for fractures and males for TBI. Finally, ‘fall on the same level from slipping, tripping, and stumbling’ was the most common fall type, followed by ‘unspecified fall’.

4. Discussion

In general, FRIs were more common in females and in the older age groups. Fractures were the most common injury type for both sexes and all age groups. Rates of fractures increased with advancing age for both sexes. Superficial injuries were the second most frequent injury type and were mainly diagnosed without another injury. Nearly 20% of patients had ICD-10-CA codes for 'other or unspecified' injuries. The most common fall code was 'fall on same level from slipping, tripping, and stumbling' in both sexes. More than 20%, of patients had codes for 'unspecified fall'. Rates of FRIs were highest in the North West LHIN which is comprised of 34% rural residences (North West Local Health Integration Network, n.d.), and the lowest rate was recorded in the Central West LHIN which was only 6% rural (Central West LHIN, n.d.).

At the ED level of care, rates of FRIs were higher in females than males, consistent with results from the United States (Mahoney et al., 2005). Findings from this thesis also suggested that the rate of FRIs increased three-fold from the youngest (65-69 years) to oldest (90+ years) age groups, while the Ontario Injury Data Report (Parachute, 2018) identified a 3.7-fold increase between the 65-69 year and 80+ year groups. The head was the most injured body part in all age groups, which aligns with findings from Parachute (2018) and DeGrauw et al. (2016). At the ED, fractures and superficial injuries were the most common injuries which was consistent with findings from the Netherlands (Olij et al., 2019). A slight decrease in the crude rates of fractures was noted between 2010 and 2014 in Ontario, which is contrary to Olij and colleagues (2019) who found a significant decrease in fall-related fractures reported to the ED in the Netherlands (2,560 in 1997 to 1,810 per 100,000 in 2016) [4]. The differences in population characteristics and healthcare systems might be partly responsible. Like all FRIs, fractures were more common in females than males and increased with advancing age.

The most common fracture locations varied by age group and sex. Forearm fractures were particularly concerning for females, as age-specific rates were 3.5 times higher than for males at the ED. Orces and Martinez (2011) also found that the combined

[4] Olij et al. (2019) calculated rates per 10,000 population. To compare, their rates they were recalculated per 100,000.

rates of forearm and wrist fractures were about four times higher in females than males aged 60 and older. Since the 1980s, rates of forearm fractures in EDs from all causes have been higher in females than males (Miller & Grimley Evans, 1985). These rates may be explained by varying trajectories of bone mass loss between sexes. Females typically see a sharp decrease in bone mass at the onset of menopause, followed by a gradual decline, while males typically experience a steady bone loss throughout adulthood and older age (Kruger & Nell, 2017). Most fractures were female-dominated, with few exceptions. For example, rib fractures were male-dominated and the second most common fracture type in males. Rib fractures were the most common fracture type in males until the 70-74 year group, after which they were surpassed by hip fractures.

Two non-fracture injury types were also male-dominated: TBI and open wounds. The most common TBIs at the ED were hemorrhages (60.2%) and concussions (31.4%). These findings were comparable to Parachute's (2015) issue of the Ontario Injury Compass Report which reported intracranial hemorrhages (42%) as the most common fall-related TBI, followed by concussions (22%). Hemorrhages were more common in males than females. It is possible that this sex-related difference could be a result of a higher proportion of males than females using anticoagulant medications (Virjo et al., 2010). Rates of TBI increased during the study period, which aligns with findings from the Netherlands between 1997 and 2016 (Olij et al., 2019). However, comparisons must be made with the caution due to variation in injury type classification between the two studies.

Hospitalization rates due to FRI were higher in females than males and increased with advancing age, consistent with the literature (Carey & Laffoy, 2002; Hartholt et al., 2010; Hartholt, Stevens, et al., 2011; Kannus, Niemi, et al., 2005; Kannus, Parkkari, et al., 2018; Korhonen et al., 2012; Nilson et al., 2016; Scott et al., 2004; Watson & Mitchell, 2011). In this study, FRI hospitalizations declined between 2010 and 2014 while conflicting time trends were reported in other studies. In Finland, there has been a decline in FRI hospitalizations (80+ years) since the 1990s (Kannus, Parkkari, et al., 2018; Korhonen et al., 2012), but an increase was reported in studies from Australia, Finland, the United States, and the Netherlands (Cassell & Clapperton, 2013; Hartholt et al., 2010; Hartholt, Stevens, et al., 2011; Kannus, Niemi, et al., 2005; Mahoney et al.,

2005; Watson & Mitchell, 2011), which could not be fully explained by population aging (Hartholt, Stevens, et al., 2011; Watson & Mitchell, 2011).

Fractures were the most common FRI injury type at the hospital, which was consistent with previous findings (Carey & Laffoy, 2005; Hartholt et al., 2010; Hartholt, Stevens, 2011; Nilson et al., 2016; Olij et al., 2019; Scott et al., 2010; Watson & Mitchell, 2011). Rates for fractures were higher in females, which could be partially explained by higher prevalence of osteoporosis and osteopenia in females (Hartholt, Stevens, et al., 2011; Orces, 2013). Hip fracture was the most common fracture type, though the proportion of hip fractures compared to other injuries has decreased over time (Cassell & Clapperton, 2013; Carey & Laffoy, 2005; Hartholt et al., 2010; Olij et al., 2019; Watson & Mitchell, 2011). This might be a consequence of improved surgical procedures that require hospital stay for upper limb fractures (Hartholt et al., 2010; Hartholt, Stevens, et al., 2011).

An unexpected finding was that superficial injuries were second (after fractures) at the hospital level of care. A Swedish study reported similar rates for superficial injuries, 344 per 100,000 females and 225 per 100,000 males, and indicated that these high rates could be due to the stress and impact of a fall on the overall health of older adults (Nilson et al., 2016). TBIs were a male-dominated injury type and became increasingly common with advancing age in both sexes, though findings from the literature were inconsistent. Studies from Australia, the United States, and Finland (Carey & Laffoy, 2005; Coronado et al., 2005; Fletcher et al., 2007; Harvey & Close, 2012; Kannus et al., 2007) found higher rates among males, while studies from Netherlands and Sweden (Hartholt, Van Lieshout, et al., 2011; Nilson et al., 2016) reported higher rates in females. This thesis reported a slight increase in the rate of TBI hospitalizations between 2010 and 2014, mirroring results from Australia, Finland, the Netherlands, and the United States (Cassell & Clapperton, 2013; Fletcher et al., 2007; Hartholt et al., 2010; Hartholt, Van Lieshout, et al., 2011; Harvey & Close, 2012; Kannus et al., 2007; Olij et al., 2019). It is unclear how improved detection of TBI (via computerized tomography scanning) or the use of anticoagulant and antiplatelet medications are contributing to this increase (Cassell & Clapperton, 2013; Hartholt, Van Lieshout, et al., 2011; Harvey & Close, 2012; Lip et al., 2011). These questions warrant further investigation.

More males than females died following an FRI at both settings of healthcare delivery, which is similar to findings on higher mortality rates in males after an FRI from the literature (Mahoney et al., 2005; Stevens et al., 1999; Stevens & Dellinger, 2002). Other studies explained that males have more comorbidities and tend to engage in more physical activity and riskier behaviours (Alamgir et al., 2012; Orces, 2008). Alamgir et al. (2012) and Orces (2008) also reported higher mortality rates with advancing age.

Exploring types of falls that lead to injuries is important to provide stakeholders with the evidence required to produce specific fall and injury prevention strategies. The most common ICD-10-CA fall code was 'fall on same level from slipping, tripping, and stumbling' (W01). More than 20% of observations had a code for 'unspecified fall' (W19) and this proportion increased with advancing age. It was not possible to determine why one-fifth of patients in this dataset had W19 codes, though it is possible that this could have been used as a generic code when the exact cause of FRI was unclear. Additionally, it was not possible to determine the reason for an age-related increase in W19 codes. This is problematic as falls and injury prevention strategies depend on specific evidence to create meaningful remedial solutions. The literature did not provide much reflection on high numbers of 'unspecified fall' codes.

Previous FRI literature did not offer much information on the types and locations of falls. Vague descriptions of the fall types that resulted in injury are available, but categorizations of fall types were inconsistent between studies. For example, a Dutch study found that 96% of hospitalizations involved 'accidental fall on same level from slipping, tripping, or stumbling', 'accidental fall on or from stairs or steps', or 'accidental fall on or from chair or bed' (Hartholt et al., 2010). Here, multiple codes were combined into a single category making it impossible to align the causes (falls) with resulting injuries.

'Falls involving ice or snow' were common at both ED and hospital level of care. Winter weather in Ontario, including heavy snowfall and icy conditions, can be present for four months or longer, placing a heavy burden on the healthcare system during this season. Therefore, ice and snow falls are an important fall type to consider for future FRI prevention strategies in Ontario. Rates for 'fall on same level involving ice and snow' (W00) remained steady through the advancing age groups in males but decreased in

females. This finding was similar to Beynon et al. (2011) where rates of hospitalizations for falls on snow and ice increased with all age groups in males and increased until age 74 in females. Miller and Grimley Evans (1985) also found that rates of distal forearm fractures were four times higher during weeks with freezing temperatures than any other time of year. Hip fractures followed a similar pattern and were more frequent in the winter months (Crawford & Parker, 2003).

4.1 Methodological Considerations

A major methodological consideration for the present study is the use of ICD-10-CA codes for injuries and falls. Although this coding system is internationally recognized and widely utilized, making it useful for comparison across populations, a large portion of the codes have limited utility, such as injury codes in the category 'other or unspecified injuries' (Appendix C, Table C3). The ICD-10-CA classification list (CIHI, 2015) contains injury categories that describe multiple injuries, unspecified injury types, unspecified body location, or more than one of these subcategories within a single code. For example, the code T019 is the classification for 'multiple open wounds of unspecified site' (CIHI, 2015, p. 835). Arbitrary grouping of injury diagnosis codes in previous studies, types of coding systems used, and issues with transcription from patient records to databases diminish our ability to provide good evidence for injury prevention.

Similarly, more than 20% of observations had an ICD-10-CA code for 'unspecified fall' (W19). Another 14.8% of observations in ED and 16.9% in hospital had codes for 'other fall on same level' (W18). This means that about 35% of all observations had unclear causes of injury. Large proportions of 'unspecified fall' codes were identified in other studies as well (Harvey & Close, 2012). A better taxonomy of ICD-10-CA codes for both injury and falls types is required.

At present, the ICD-10 is the latest version of the disease classification system used. The ICD-11 version was approved by the World Health Assembly in 2019, is now pilot tested and will come into effect in 2022 (CIHI, n.d.). This suggests that any changes in the categorization or grouping of ICD codes for injuries and falls will have to wait for the ICD-12 version.

4.2 Strengths and Limitations

Several strengths of this study must be highlighted, including the use of a large population-based dataset that was representative of the entire population of older adults with FRIs at the time of an ED admission over the period of five years. This eliminated re-call bias and self-reporting bias. The use of ED and hospital level data allowed for a closer estimate of the magnitude of FRIs. It also allowed for continuity in following the same population from entry point into the healthcare system (ED), to hospital discharge. Studies that have examined only FRI hospitalizations have underestimated the total number of cases and their impact on healthcare systems (Fletcher et al., 2007; Harvey & Close, 2012). Additionally, in this study, only one observation per person was included, removing a chance of double-registration.

Every observation in this dataset could have up to ten ICD-10-CA diagnosis codes which allowed for examination of all FRIs rather than only the cases with a single primary diagnosis of injury. Studies that included only primary diagnoses were not reflective of all the injuries (Watson & Mitchell, 2011; Nilson et al., 2016). Finally, this study contributed information about less serious and less common injuries in detail, such as rib fractures, open wounds, or superficial injuries. Although they are not of the most pressing concern to the overburdened healthcare system in Ontario, it is important to consider all injuries that result in utilization of healthcare resources.

There were several limitations to this study that must be acknowledged. First, secondary data that is routinely collected for administrative healthcare databases for the population of Ontario, Canada was analyzed. ICD-10 coding is an internationally recognized diagnosis classification system and is utilized in the healthcare system by trained coders based on an instruction manual that accompanies ICD-10-CA (CIHI, 2018). However, the author did not have control over data collection, therefore it is not possible to rule out errors in data collection and coding processes. Second, the dataset was extracted from three large healthcare databases (i.e., NACRS, DAD, RPDB) by a trained IC/ES analyst based on a specific Dataset Creation Plan (Appendix B). Although the Dataset Creation Plan included clear details for the data required for the study, there was still room for data analyst's interpretation of this request. Third, IC/ES imposed an upper age limit of 91 years, meaning anyone older than that was listed as 91 years old.

This meant that it was not possible to break down the oldest age group (90+ years) for further interpretation, such as common FRIs among centenarians. This limitation provided a basis for further research on FRIs among Ontarians 90 years and older. Fourth, the overall findings from this study may be an underestimate of the impact of FRIs in Ontario healthcare system as the dataset did not include patients who: 1) were treated for an FRI by their family physician or at a walk-in clinic, 2) were treated out of the province, 3) failed to identify a fall as the cause of injury during ED admission, 4) died prior to admission to the ED, or 5) were directly admitted to hospital without being registered at the ED. Future FRI research in Ontario should seek to include these areas of medical services to identify the total impact of FRIs on Ontario's healthcare system. Fifth, the dataset included older adults from a single Canadian province and therefore may not be generalizable to other Canadian provinces or territories, or other societies due to differences in demographic make-up and healthcare protocols. Sixth, causes of death from death certificates were not included in this dataset, therefore it was not possible to calculate mortality rates due to FRIs. However, the inclusion of rates of death after FRIs and proportions of patients who died within one year after FRIs provided a basis for future research on FRI-related mortality in Ontario. Finally, the five-year observation window (2010-2014) is dated, but this was the most up-to-date full dataset available at the time of data request in 2017. Advantageously, this timeframe aligns well with the entry of the baby boomer generation (i.e., people born between 1946 and 1964) into the retirement age, starting in 2011, providing a baseline for future FRI trend analysis on FRIs in the baby boomer generation.

4.3 Implications for Future Research and Falls Prevention

Epidemiological information about FRIs and falls is essential for allocating healthcare resources and guidance for prevention strategy creation and implementation. Targeted prevention strategies based on personal demographic characteristics (e.g., age, sex, location, income) may be a cost-effective alternative to a blanket national public health strategy. Moreover, prevention must change with patient needs and fluctuating risks.

The author supports the need for better injury types classification to improve the future of FRI research. The future ICD codes need to better categorize specific injury types. For example, differentiating body location and defining exact injury type while

avoiding groupings such as, ‘sprain, strain, or dislocation’. Another recommendation would be to ensure the healthcare practitioners ask patients with potential FRIs detailed information about the fall event itself. The goal would be to reduce the number of FRI events coded as ‘unspecified falls’ (W19), thus allowing for a clearer picture of what fall types are most problematic for the older adult population.

The future of FRI research should seek to identify causal relationships between various fall types, injuries, and the characteristics of individuals who experience them. The present descriptive study provided evidence to guide the direction for future research endeavors. The review of population-based FRI literature presented in the introduction has shown that some injury types (e.g. TBI and fractures) were frequently studied, while other injuries, like rib fracture which can cause life-threatening pulmonary complications (Bulger et al., 2000), were rarely mentioned. Based on findings reported here, the following is a list of recommendations for future FRI research in Ontario:

- Identify causal relationships between demographic characteristics and injury types, especially focusing on infrequently studied injury types.
- Examine the link between types of injuries and falls at a population level.
- Examine the impact of chronic conditions and other health indicators, such as osteoporosis, asthma, COPD, body mass index, and bone mineral density on types of injuries and falls.
- Identify causal relationships between injury types and use of various medications.
- Explore associations between types of falls, injuries, and demographics of first-time versus recurrent fallers at the ED and hospital levels.
- Explore how various FRIs in urban centres in Ontario differ from FRIs in rural and Indigenous communities.
- Explore the role of fall-related superficial injuries leading to hospitalizations.
- Examine the types of injuries and falls in special populations in Ontario, such as clients receiving home care or long-term care residents.

Although it was beyond the scope of this study to identify risk factors for falls or to test prevention strategies, some higher-level FRI prevention recommendations can be made based on the findings presented in this thesis. Females and individuals in the older age groups experienced FRIs at higher rates than males and younger older adults and

should therefore receive the most attention in prevention efforts. It is also important to recognize that FRI types and causes differed among individuals based on their demographic characteristics, such as age and sex. As individuals got older, the common injury types changed, therefore FRI prevention should target the consequential injuries that they are most likely to experience based on their demographic characteristics.

5. Conclusion

FRIs are a considerable problem for older adults in Ontario, and a burden on the healthcare system. This population-based descriptive study examined data for 304,610 older adults admitted to the ED, and 143,210 patients subsequently hospitalized. Research on FRIs is vast, but there was no peer-reviewed published literature on FRIs for the Canadian province of Ontario. The purpose of this thesis was to identify demographic characteristics of older adults who experienced FRIs and to describe the types of FRIs and the falls that caused them.

Females had higher overall rates of FRIs than males. FRIs increased nearly three-fold from the youngest age group (65-69 years) to the oldest (90+ years), and this age-related increase was sharper in males than females. The sex- and age-related patterns were consistent with findings from the literature. The types and body locations of injuries changed with advancing age. Fractures were the most common injury type in both sexes, followed by superficial injuries. Most injury types were female-dominated except for TBIs, open wounds, muscle and tendon injuries, and internal organ injuries. The ICD-10-CA code ‘fall on same level from slipping, tripping, and stumbling’ was the most common fall type for most injuries. However, over 35% of observations had codes for ‘unspecified fall’ (W19) or ‘other fall on same level’ (W18), making it impossible to draw meaningful conclusions on causes of injuries. This means that FRIs will likely remain a burden for Ontario’s EDs and hospitals in the coming decades. A better understanding of fall types that cause injuries will help create meaningful and effective FRI prevention protocols. These programs need to target injury types that are more serious (i.e., result in hospitalization) and should align with an individual’s specific risks as they age. This study provides evidence that can guide fall-related injury prevention at the population level, reduce the burden on the healthcare system, and most importantly prevent suffering of older adults who experience injuries.

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Appendices

Appendix A. Ethics Approval

Western Research

Date: 12 July 2018

To: Aleksandra Zecevic

Project ID: 109335

Study Title: The Association Between Health Indicators and Serious Fall-related Injuries in Older Adults

Application Type: Continuing Ethics Review (CER) Form

Review Type: Delegated

REB Meeting Date: 07/Aug/2018

Date Approval Issued: 12/Jul/2018

REB Approval Expiry Date: 10/Jul/2019

*****Lapse in Approval: July 11, 2018 to July 12, 2018*****

Dear Aleksandra Zecevic,

The Western University Research Ethics Board has reviewed the application. This study, including all currently approved documents, has been re-approved until the expiry date noted above.

REB members involved in the research project do not participate in the review, discussion or decision.

Western University REB operates in compliance with, and is constituted in accordance with, the requirements of the TriCouncil Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2); the International Conference on Harmonisation Good Clinical Practice Consolidated Guideline (ICH GCP); Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations; Part 3 of the Medical Devices Regulations and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. The REB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Please do not hesitate to contact us if you have any questions.

Sincerely,

Daniel Wyzynski, Research Ethics Coordinator, on behalf of Dr. Joseph Gilbert, HSREB Chair

Note: This correspondence includes an electronic signature (validation and approval via an online system that is compliant with all regulations).

Western Research

Date: 7 July 2019

To: Aleksandra Zecevic

Project ID: 109335

Study Title: The Association Between Health Indicators and Serious Fall-related Injuries in Older Adults

Application Type: Continuing Ethics Review (CER) Form

Review Type: Delegated

REB Meeting Date: 16/Jul/2019

Date Approval Issued: 07/Jul/2019

REB Approval Expiry Date: 10/Jul/2020

Dear Aleksandra Zecevic,

The Western University Research Ethics Board has reviewed the application. This study, including all currently approved documents, has been re-approved until the expiry date noted above.

REB members involved in the research project do not participate in the review, discussion or decision.

Western University REB operates in compliance with, and is constituted in accordance with, the requirements of the TriCouncil Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2); the International Conference on Harmonisation Good Clinical Practice Consolidated Guideline (ICH GCP); Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations; Part 3 of the Medical Devices Regulations and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. The REB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Please do not hesitate to contact us if you have any questions.

Sincerely,

Daniel Wyzynski, Research Ethics Coordinator, on behalf of Dr. Joseph Gilbert, HSREB Chair

Note: This correspondence includes an electronic signature (validation and approval via an online system that is compliant with all regulations).

Western Research

Date: 15 June 2020

To: Aleksandra Zecevic

Project ID: 109335

Study Title: The Association Between Health Indicators and Serious Fall-related Injuries in Older Adults

Application Type: Continuing Ethics Review (CER) Form

Review Type: Delegated

REB Meeting Date: 16/Jun/2020

Date Approval Issued: 15/Jun/2020

REB Approval Expiry Date: 10/Jul/2021

Dear Aleksandra Zecevic,

The Western University Research Ethics Board has reviewed the application. This study, including all currently approved documents, has been re-approved until the expiry date noted above.

REB members involved in the research project do not participate in the review, discussion or decision.

Western University REB operates in compliance with, and is constituted in accordance with, the requirements of the TriCouncil Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2); the International Conference on Harmonisation Good Clinical Practice Consolidated Guideline (ICH GCP); Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations; Part 3 of the Medical Devices Regulations and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. The REB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Please do not hesitate to contact us if you have any questions.

Sincerely,

Daniel Wyzynski, Research Ethics Coordinator, on behalf of Dr. Joseph Gilbert, HSREB Chair

Note: This correspondence includes an electronic signature (validation and approval via an online system that is compliant with all regulations).

Appendix B. Dataset Creation Plan

ICES

Dataset Creation Plan

Project Initiation This Section must be Completed Prior to Project Dataset(s) Creation		
Project Title:	The association between selected health indicators, prescription medications and serious fall-related injuries in older adults (REVISED July 2019)	
Project TRIM number:		
Research Program:	DAS	
Site:	ICES Western	
Project Objectives:	*Insert Project Objectives as listed in the approved ICES Project PIA*	
	The objective of this study is to investigate the association between selected health indicators, prescription medications and serious fall-related injuries in older adults	
ICES Project PIA Initial Approval Date:	*The ICES Employee or agent who is responsible for creating the Project Dataset(s) is responsible for ensuring there is an approved ICES Project PIA and verifying the date of approval prior to creating the Project Dataset(s)*	
	2017-Jul-12	
Principal Investigator (PI):	Aleksandra Zecevic	
Check the applicable box if the PI is an ICES Student/Trainee	☐ ICES Student ☐ ICES Fellow ☐ ICES Post-Doctoral Trainee ☐ Visiting Scholar	
Responsible ICES Scientist:	*Name the Responsible ICES Scientist if the PI is not a Full Status ICES Scientist*	
Project Team Member(s) Responsible for Project Dataset Creation and/or Statistical Analysis and date joined (list all):	*All person(s) (ICES Analyst, Appointed Analyst, Analytic Epidemiologist, PI, and/or Student) responsible for creating the Project Dataset(s) and/or statistical analysis on the Research Analytics Environment (RAE) and the date they joined the project must be recorded*	
	Aleksandra Zecevic, Yu Ming	2017-Jul-12
	~~Tyson Schierholtz~~	~~2017-Dec-01~~
	Nicolette Lappan	2018-Nov-6
Other ICES Project Team Members and date joined (list all):	*All other Research Project Team Members (e.g., Research Administrative Assistants, Research Assistants, Project Managers, Epidemiologists) and the date they joined the project must be recorded*	
		yyyy-mon-dd
Confirmation that DCP is consistent with Project Objectives:	*The following individuals must confirm that the ICES Data provided for in this DCP is relevant (e.g., with respect to cohort, timeframe, and variables) and required to achieve the Project Objectives stated in the ICES Project PIA prior to initial Project Dataset creation: 1) PI; 2) Responsible ICES Scientist if the PI is not a Full Status ICES Scientist, or a second ICES Scientist or the Scientific Program Lead if the PI is creating both the DCP and the Project Dataset[s]; 3) ICES Research and Analysis Staff creating the DCP; and 4) ICES Analytic Staff (ICES Employee or agent responsible for creating the Project Dataset[s]). This may be delegated either verbally or via e-mail.*	
	Principal Investigator Aleksandra Zecevic ☐	2017-Aug-21
	Responsible ICES Scientist or Second ICES Scientist/Lead ☐	yyyy-mon-dd
	ICES Research and Analysis Staff Creating the DCP ☐	yyyy-mon-dd
	ICES Analytic Staff ☐	yyyy-mon-dd
Designated ICES Research and Analysis Staff accountable for Project Documentation:	*The person named (ICES staff) is accountable for ensuring that the approved ICES Project PIA, ICES Project PIA Amendments, and DCP are saved on the T Drive, ensuring ICES Project PIA Amendments are submitted as required, ensuring DCP Amendments are documented, and sharing the final DCP with the PI/Responsible ICES Scientist at project completion*	
DCP Creation Date and Author:	*Date DCP was finalized prior to Project Dataset(s) creation*	*Name of person who created the DCP*
	Date	***Name***

Dataset Creation Plan

Project Initiation This Section must be Completed Prior to Project Dataset(s) Creation		
	2017-Aug-20	***Yu Ming, Tyson Schierholtz, Aleksandra Zecevic***
	2019-Jul-8	***Nicolette Lappan***

Dataset Creation Plan

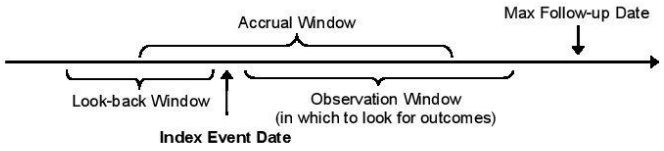
ICES Data This Section must be Completed Prior to Project Dataset(s) Creation	
The ICES Employee or agent who is responsible for creating the Project Dataset(s) must ensure that this list includes only data listed in the ICES Project PIA *Changes to this list after initial ICES Project PIA approval require an ICES Project PIA Amendment*	*Mandatory for all datasets that are available by individual year*
General Use Datasets – Health Services	***Years (where applicable)***
See list	
See list	
General Use Datasets – Care Providers	
See list	
See list	
General Use Datasets – Population	
See list	
See list	
General Use Datasets – Coding/Geography	
See list	
See list	
General Use Datasets - Facilities	
See list	
General Use Datasets - Other	
See list	
See list	
Controlled Use Datasets	
See list	
See list	
Other Datasets	

Project Amendments and Reconciliation			
ICES Project PIA Amendment History (add additional rows as needed):	*Privacy approval date*	*Person who submitted amendment*	*Note that any changes to the list of ICES Data or Project Objectives require an ICES Project PIA Amendment*
	Date	***Name***	***Amendment***
	yyyy-mon-dd		
DCP Amendment History (add additional rows as needed):	*Date DCP amended*	*Person who made the DCP amendment*	*Note that any DCP amendments involving changes to the list of ICES Data or Project Objectives require an ICES Project PIA Amendment*
	Date	***Name***	***Amendment***
	yyyy-mon-dd		
Date Programs/DCP reconciled	*The person(s) creating the dataset and/or analyzing the data are responsible for ensuring that the final DCP reflects the final program(s) when the project is completed*		
	yyyy-mon-dd		

Project Cohort	
Study Design	☐ Cohort study ☐ Matched cohort study ☒ Case-control study ☐ Cross-sectional study ☐ Other (specify):
Index Event / Inclusion Criteria	• Serious Fall-Related Injuries and Death (Appendix A – ICD-10 W, S and T codes). When cutting a cohort of cases, please keep information on all 10 diagnostic codes from NACRS (e.g., dx10code1 – dx10code10), so we can confirm W code is combined with S or T code (e.g., S and W, T and W, S&T and W) to make it "fall-related". **Case group** inclusion criteria: a) Older adults 65 years and older b) Residents of Ontario c) Presented to Emergency Department d) Diagnosed with a serious fall-related injury or death due to fall-related injury. Fall-related injury is defined by combining ICD-10 codes for falls W00-W19 with ICD-10 codes for injuries S00-S99 or T00-T14. The time between codes W00-W19 and codes S00-S99 or T00-T14 should be the same day. Descriptive information (e.g., brakedown of S00-S99 or T00-T14 and W00-W19 codes) should be included into the dataset to allow analysis of injury types.) e) Diagnosed between Jan 1 2006 and Dec 31 2015. **Control group** a) Matched to the case group by sex, age Charlson Comorbidity Index score, and LHIN, with a ratio of 1.5 to 1. b) Exclude the patients having serious fall-related injuries (codes W00-W19, codes S00-S99 or T00-14) between Jan 1, 2006 and Dec 31, 2015. • The date of visiting Emergency Department due to serious fall-related injury will be defined as the index event date. • For individuals with repetitive serious fall-related injuries during the observation period, the first time and consecutive visits to ED due to serious fall-related injury will be taken into account.
Estimated Size of Cohort (if known)	
Exclusions (in order)	*Step* Description

Project Cohort		
	1	Invalid IKN
	2	Incomplete information (e.g, missing age or missing sex information, non-Ontario residents, died before ED visits)
	3	<65 years old at the index event date
	4	Patients who have experienced in-hospital serious fall-related injuries
	5	Excluding diagnoses that are suspected, questionable, rule out.
	6	Excluding transferred ED visits.
	7	Excluding ED visits from which a patient left without being seen.
	8	Excluding scheduled ED visits.

Project Time Frame Definitions



Accrual Start/End Dates	2006 Jan 1st to 2015 December 31st
Max Follow-up Date	2017 Jan 1st
When does observation window terminate?	12 months after the index date
Lookback Window(s)	12 months (till 2005 Jan 1st)

Variable Definitions (add additional rows as needed)	
Main Exposure or Risk Factor	For the full list of variables, please refer to Appendix B – Variables from NACRS, CIHI-DAD, RAI-HC and ODB.
Primary Outcome Definition	Serious fall-related injuries (ICD-10 codes W00-W19 combined with S00-S99 or T00-T14 ICD-10 codes)
Secondary Outcome Definition(s)	Death
Baseline Characteristics	Case and Control: age, sex, Charlson Comorbidity Index score, LHIN
Other Variables	Variables needed from NACRS, CIHI-DAD, RAI-HC and ODB databases are provided in attached file (Appendix B). IMPORTANT: to reduce number of observations we decided NOT to proceed with analysis of OHIP data, hence we excluded it in this revision.

Analysis Plan and Dummy Tables (expand/modify as needed)	
Descriptive Tables (insert or append dummy tables), e.g.: See Appendix C and Appendix D	
Table 1. Baseline characteristics according to primary/secondary exposure	Descriptive statistics, measures of central tendency and dispersion for continuous variables, and frequency tables for categorical variables. Trends in the data across time will also be analyzed.
Table 2. Outcomes according to primary/secondary exposure: See dummy tables in Appendix D	
Table 3. Covariates (baseline characteristics) according to outcomes : See dummy tables in Appendix D	
Statistical Model(s)	
Type of model	Cox Proportional Hazard Regression
Primary independent variable	Risk factors mentioned above
Dependent variable	Serious fall-related injuries and death
Covariates	
Sensitivity Analyses	
Type of model	
Primary independent variable	
Dependent variable	
Covariates	

Quality Assurance Activities			
RAE Directory of SAS Programs			
RAE Directory of Final Dataset(s)	*The final analytic dataset for each cohort includes all the data required to create the baseline tables and run all the models. It should include all covariates for all models such as patient risk factors, hospital characteristics, physician characteristics, exposure measures (continuous, categorical) and outcomes. It should include covariates that were considered but didn't make the final cut. This would permit an analyst to easily re-run the models in the future.*		
RAE README file available:	☐Yes ☐No		
Date results of quality assurance tools for final dataset shared with project team (where applicable):			
		%assign	yyyy-mon-dd
		%evolution	yyyy-mon-dd
		%dinexplore	yyyy-mon-dd
		%track / %exclude	yyyy-mon-dd
		%codebook	yyyy-mon-dd
Additional comments:			

Appendix C. List of ICD-10-CA Codes

Table C1
Codes for Fall Types based on the International Classification of Diseases Tenth Edition with Canadian Enhancements

Fall type	ICD-10-CA code
Fall on same level involving ice and snow	W00
Fall on same level from slipping, tripping and stumbling	W01
Fall involving skates, skis, sport boards and in-line skates	W02
Other fall on same level due to collision with, or pushing by, another person	W03
Fall while being carried or supported by other persons	W04
Fall involving wheelchair and other types of walking devices	W05
Fall involving wheelchair	W0500
Fall involving walker	W0501
Fall involving bed	W06
Fall involving chair	W07
Fall involving other furniture	W08
Fall involving playground equipment	W09
Fall on and from stairs and steps	W10
Fall on and from ladder	W11
Fall on and from scaffolding	W12
Fall from, out of or through building or structure	W13
Fall from tree	W14
Fall from cliff	W15
Diving or jumping into water causing injury other than drowning or submersion	W16
Other fall from one level to another	W17
Other fall on same level	W18
Unspecified fall	W19

Note. CIHI, 2015. ICD 10-CA = International Classification of Diseases Tenth Edition with Canadian Enhancements.

Table C2
Codes for Body Locations based on the International Classification of Diseases Tenth Edition with Canadian Enhancements

Body location	ICD 10-CA codes
Head	S00-S09
Neck	S10-S19
Trunk	S20-S29 (thorax)
	S30-S39 (abdominal, lower back, lumbar spine and pelvis)
	T08, T09 (spine, trunk)
Upper limb	S40-S49 (shoulder and upper arm)
	S50-S59 (elbow and forearm)
	S60-S69 (wrist and hand)
	T10, T11 (level unspecified)
Lower limb	S70-S79 (hip and thigh)
	S80-S89 (knee and lower leg)
	S90-S99 (ankle and foot)
	T12, T13 (level unspecified)
Multiple regions	T00-T07
Unspecified level	T14 (unspecified body region)

Note. CIHI, 2015. ICD 10-CA = International Classification of Diseases Tenth Edition with Canadian Enhancements.

Table C3

Codes for Injury Types based on the International Classification of Diseases Tenth Edition with Canadian Enhancements

Injury type	ICD-10-CA codes
Fracture	S02, S12, S22, S32, S42, S52, S62, S72, S82, S92, T02, T08, T10, T12, T142
Superficial	S00, S10, S20, S30, S40, S50, S60, S70, S80, S90, T00, T090, T110, T130, T140
Open wound	S01, S11, S21, S31, S41, S51, S61, S71, S81, S91, T01, T091, T111, T131, T141
Sprain, strain, tear	S034, S035, S134, S135, S136, S233, S234, S235, S335, S336, S337, S434-S437, S532, S533, S534, S633, S634, S635, S636, S637, S731, S832, S833, S834, S835, S836, S932, S934, S935, S936
TBI	S060, S061, S062, S063, S064, S065, S066, S067, S068, S069
Dislocation	S030, S031, S032, S033, S131, S132, S133, S231, S232, S331, S332, S333, S430, S431, S432, S433, S530, S531, S630, S631, S632, S730, S830, S831, S930, S931, S933
Muscle, fascia, tendon	S091, S16, S290, S390, S46, S56, S66, S76, S86, S96, T064, T095, T115, T135, T146
Internal organ	S26, S27, S36, S37, S396, T065
Other or unspecified	S092, S097, S098, S099, S130, S197, S198, S199, S230, S297, S298, S299, S330, S334, S397, S398, S399, S497, S498, S499, S597, S598, S599, S697, S698, S699, S797, S798, S799, S837, S897, S898, S899, S997, S998, S999, T03, T060, T061, T068, T07, T098, T099, T112, T118, T119, T132, T138, T139, T143, T148, T149

Note. TBI = Traumatic Brain Injury. ICD 10-CA = International Classification of Diseases Tenth Edition with Canadian Enhancements. CIHI, 2015.

Table C4

Codes for Fracture by Body Location based on the International Classification of Diseases Tenth Edition with Canadian Enhancements

Body location	ICD 10-CA codes
Head	S02 (skull and face)
Neck	S120, S121, S122, S127 (cervical spine)
	S128, S129 (other neck)
Trunk	S220, S221 (thoracic spine)
	S222 (sternum)
	S223, S224, S225 (ribs)
	S228, S229 (other thorax)
	S320 (lumbar spine)
	S321, S322, S323, S324, S325 (pelvis)
	S327, S328 (other abdomen)
	T021 (thorax, lower back, pelvis)
Spine (all levels)	S120, S121, S122, S127 (cervical spine)
	S220, S221 (thoracic spine)
	S320 (lumbar spine)
	T08 (unspecified level)
Abdomen	S320 (lumbar spine)
	S321, S322, S323, S324, S325 (pelvis)
	S327, S328 (other abdomen)
Shoulder and upper arm	S420 (clavicle)
	S421 (scapula)
	S422, S423, S424 (humerus)
	S422 (proximal humerus)
	S427, S428, S429 (other and multiple shoulder or upper arm)
Forearm	S52
Wrist and hand	S62
Hip and thigh	S720, S721, S722 (hip)
	S723, S724, S727, S728, S729 (femur)
Knee and lower leg	S820, S821, S822, S823, S824, S827, S829 (knee, lower leg)
	S825, S826, S828 (ankle)
Foot	S92
Multiple body regions	T020 (head + torso)
	T021 (thorax + lower back or pelvis)
	T022 (multiple locations on one upper limb)
	T023 (multiple locations on one lower limb)
	T024 (both upper limbs)
	T025 (both lower limbs)
	T026, T027, T028, T029 (other multiple regions)
Unspecified level	T08 (spine)
	T10 (upper limb)
	T12 (lower limb)
Unspecified fracture	T142

Note. CIHI, 2015. ICD 10-CA = International Classification of Diseases Tenth Edition with Canadian Enhancements.

Table C5

Codes for Superficial Injuries by Body Location based on the International Classification of Diseases Tenth Edition with Canadian Enhancements

Body location	ICD 10-CA codes
Head	S00
Neck	S10
Trunk	S20 (thorax)
	S30 (abdomen)
	T090 (level unspecified)
Upper limb	S40 (shoulder and upper arm)
	S50 (elbow and forearm)
	S60 (wrist and hand)
	T110 (level unspecified)
Lower limb	S70 (hip and thigh)
	S80 (knee and lower leg)
	S90 (ankle and foot)
	T130 (level unspecified)
Multiple body regions	T00
Unspecified body region	T140

Note. CIHI, 2015. ICD 10-CA = International Classification of Diseases Tenth Edition with Canadian Enhancements.

Table C6

Codes for Open Wounds by Body Location based on the International Classification of Diseases Tenth Edition with Canadian Enhancements

Body location	ICD 10-CA codes
Head	S01
Neck	S11
Trunk	S21 (thorax)
	S31 (abdomen)
	T011 (thorax or abdomen)
	T090 (level unspecified)
Upper limb	S41 (shoulder and upper arm)
	S51 (elbow and forearm)
	S61 (wrist and hand)
	T012 (multiple locations)
	T111 (level unspecified)
Lower limb	S71 (hip and thigh)
	S81 (knee and lower leg)
	S91 (ankle and foot)
	T013 (multiple locations)
	T131 (level unspecified)
Multiple body regions	T010 (head + neck)
	T016 (upper + lower limbs)
	T018, T019 (other or unspecified multiple regions)
Unspecified body region	T141

Note. CIHI, 2015. ICD 10-CA = International Classification of Diseases Tenth Edition with Canadian Enhancements.

Table C7

Codes for Sprains, Strains, or Tears by Body Location based on the International Classification of Diseases Tenth Edition with Canadian Enhancements

Body location	ICD 10-CA codes
Head	S034 (jaw)
	S035 (other or unspecified)
Neck	S134 (cervical vertebrae)
	S135 (thyroid region)
	S136 (other or unspecified
Thorax	S233 (thoracic vertebrae)
	S234 (ribs and sternum)
	S235 (other or unspecified)
Lumbar spine and pelvis	S335 (lumbar spine)
	S336 (sacroiliac joint)
	S337 (other or unspecified)
Shoulder and upper arm	S434 (shoulder joint)
	S435 (acromioclavicular joint)
	S436 (sternoclavicular joint)
	S437 (other or unspecified)
Elbow and forearm	S532 (rupture of radial collateral ligament)
	S533 (rupture of ulnar collateral ligament)
	S534 (sprain or strain of elbow)
Wrist and hand	S633 (ligament rupture of wrist and carpus)
	S634 (ligament rupture of finger)
	S635 (sprain or strain of wrist)
	S636 (sprain or strain of finger)
	S637 (other sprain or strain)
Hip	S731
Knee and lower leg	S832 (tear of meniscus)
	S833 (tear of articular cartilage)
	S834 (collateral ligaments)
	S835 (cruciate ligaments)
	S832 (unspecified sprain or strain of knee)
Ankle and foot	S932 (rupture of ligament at ankle or foot)
	S934 (sprain or strain of ankle)
	S935 (sprain or strain of toe)
	S936 (other sprain or strain)

Note. CIHI, 2015. ICD 10-CA = International Classification of Diseases Tenth Edition with Canadian Enhancements.

Table C8

Codes for Traumatic Brain Injuries by Type based on the International Classification of Diseases Tenth Edition with Canadian Enhancements

Type of TBI	ICD 10-CA codes
Concussion	S060
Diffuse brain injury	S062
Focal brain injury	S063
Haemorrhage	S064, S065, S066, S067, S068
Other TBI	S061, S069

Note. CIHI, 2015. TBI = Traumatic Brain Injury. ICD 10-CA = International Classification of Diseases Tenth Edition with Canadian Enhancements.

Table C9

Codes for Dislocations by Body Location based on the International Classification of Diseases Tenth Edition with Canadian Enhancements

Body location	ICD 10-CA codes
Head	S030 (jaw)
	S031 (nose)
	S032 (tooth)
	S033 (unspecified)
Neck	S131 (cervical vertebrae)
	S132 (other or unspecified)
	S133 (multiple dislocations)
Thorax	S231 (thoracic vertebrae)
	S232 (other or unspecified)
Lumbar spine and pelvis	S331 (lumbar vertebrae)
	S332 (sacroiliac or sacrococcygeal joint)
	S333 (other or unspecified)
Shoulder and upper arm	S430 (shoulder)
	S431 (acromioclavicular joint)
	S432 (sternoclavicular joint)
	S433 (other or unspecified shoulder)
Elbow and forearm	S530 (radial head)
	S531 (elbow)
Wrist and hand	S630 (wrist)
	S631 (finger)
	S632 (multiple fingers)
Hip	S730
Knee and lower leg	S830 (patella)
	S831 (knee)
Ankle and foot	S930 (ankle)
	S931 (metatarsophalangeal joint)
	S933 (other foot)

Note. CIHI, 2015. TBI = traumatic brain injury. ICD 10-CA = International Classification of Diseases Tenth Edition with Canadian Enhancements.

Table C10

Codes for Locations of Fall-Related Injury Events based on the International Classification of Diseases Tenth Edition with Canadian Enhancements

Injury location	ICD-10-CA codes
Home	U980
Residential institution	U981
School, other institution, public	U982
Sports and athletics area	U983
Street and highway	U984
Trade and service area	U985
Industrial and construction area	U986
Farm	U987
Other specified	U988
Unspecified	U989

Note. CIHI, 2015. ICD 10-CA = International Classification of Diseases Tenth Edition with Canadian Enhancements.

Appendix C. Ontario Population Estimates for Older Adults

Table D1
Population of Older Adults in Ontario by Age Group and Year

Age group (years)	2010	2011	2012	2013	2014	Total
65-69	545,176	570,269	616,006	654,852	686,061	3,072,364
70-74	429,734	441,675	455,534	474,736	493,339	2,295,018
75-79	353,355	355,908	359,678	366,520	376,139	1,811,600
80-84	265,780	271,772	277,039	280,963	284,239	1,379,793
85-89	162,691	166,263	171,242	175,981	179,180	855,357
90+	75,999	82,943	89,716	95,627	101,967	446,252
Total	1,832,735	1,888,830	1,969,215	2,048,679	2,120,925	9,860,384

Note. Statistics Canada, n.d.

Table D2
Population of Female Older Adults in Ontario by Age Group and Year

Age group (years)	2010	2011	2012	2013	2014	Total
65-69	284,066	296,657	319,859	340,063	356,670	1,597,315
70-74	229,826	236,070	243,179	252,910	261,926	1,223,911
75-79	194,649	195,549	197,043	200,118	205,191	992,550
80-84	156,544	158,601	160,416	161,614	162,541	799,716
85-89	106,143	107,926	109,827	111,359	112,083	547,338
90+	55,489	60,100	64,639	68,828	73,139	322,195
Total	1,026,717	1,054,903	1,094,963	1,134,892	1,171,550	5,483,025

Note. Statistics Canada, n.d.

Table D3
Population of Male Older Adults in Ontario by Age Group and Year

Age group (years)	2010	2011	2012	2013	2014	Total
65-69	261,110	273,612	296,147	314,789	329,391	1,475,049
70-74	199,908	205,605	212,355	221,826	231,413	1,071,107
75-79	158,706	160,359	162,635	166,402	170,948	819,050
80-84	109,236	113,171	116,623	119,349	121,698	580,077
85-89	56,548	58,337	61,415	64,622	67,097	308,019
90+	20,510	22,843	25,077	26,799	28,828	124,057
Total	806,018	833,927	874,252	913,787	949,375	4,377,359

Note. Statistics Canada, n.d.

Appendix D. Ontario Standard Population for Age-Standardized Rates

Table E1

Standard Population of Older Adults by Age Group and Sex

Age group (years)	Population of both sexes	Weight of both sexes [a]	Population of females	Population of males
65+	1,878,325	N/A	1,045,215	833,105
65-69	563,485	30.0%	292,610	270,875
70-74	440,785	23.5%	234,430	206,350
75-79	356,150	19.0%	194,805	161,340
80-84	271,510	14.5%	157,890	113,615
85-89	165,775	8.8%	107,370	58,410
90+	80,620	4.3%	58,110	22,515

Note. [a] Weight calculated by dividing population for a given age group by the entire population; weights were rounded to the nearest single decimal. Population counts were rounded to the nearest five people. Statistics Canada, 2019.

Appendix E. LHIN Populations in 2013

Table F1

Population of Older Adults per Local Health Integration Network in 2013 Only

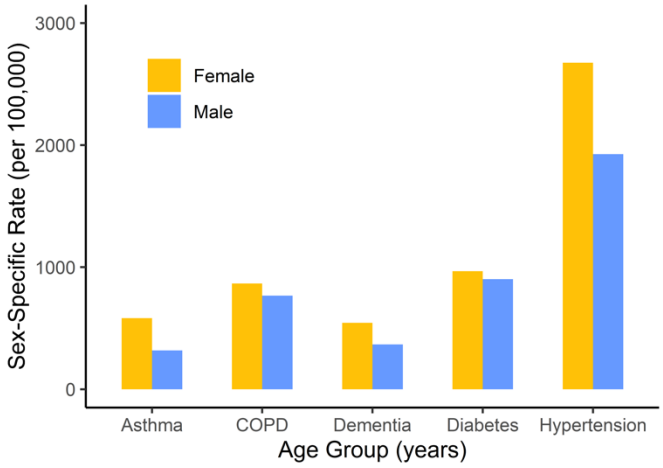
LHIN	N
1. Erie St. Clair	101,420
2. South West	153,395
3. Waterloo Wellington	94,130
4. Hamilton Niagara Haldimond Brant	230,015
5. Central West	89,755
6. Mississauga Halton	132,920
7. Toronto Central	151,245
8. Central	225,965
9. Central East	224,400
10. South East	90,550
11. Champlain	175,575
12. North Simcoe Muskoka	74,165
13. North East	99,410
14. North West	35,400

Note. LHIN = Local Health Integration Network. Rates were reported per 100,000. Statistics Canada, 2017b

Appendix F. Results for Chronic Conditions at Emergency Department and Hospital

Figure G1

Patients with Chronic Conditions at the Emergency Department by Sex (2010-2014)



Note. Sex-specific rates were calculated with total number of observations among older adults per sex as the numerator, and the sum of Ontario's population over the five years per sex as the denominator. COPD = Chronic Obstructive Pulmonary Disease.

Table G1

Chronic Conditions in Female Patients at the Emergency Department by Injury Type (2010-2014)

Injury Type	Asthma		COPD		Dementia		Diabetes		Hypertension	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Fracture	13,185 (15.4)	240	20,511 (23.9)	374	12,878 (15.0)	235	22,0467 (25.7)	402	64,096 (74.7)	1,169
Face, skull	462 (15.4)	8	631 (21.0)	12	460 (15.3)	8	846 (28.2)	15	2,327 (77.5)	42
Vertebral	581 (17.0)	11	966 (28.3)	18	540 (15.8)	10	919 (26.9)	17	2,684 (78.5)	49
Clavicle	209 (15.7)	4	317 (23.8)	6	216 (16.2)	4	294 (22.1)	5	975 (73.3)	18
Rib	785 (17.3)	14	1,329 (29.2)	24	613 (13.5)	11	1,304 (28.7)	24	3,614 (79.5)	66
Humerus	1,586 (15.4)	29	2,535 (24.6)	46	1,391 (13.5)	25	3,054 (29.6)	56	7,877 (76.5)	144
Forearm	2,921 (14.8)	53	4,029 (20.4)	73	1,807 (9.2)	33	4,128 (20.9)	75	13,604 (68.9)	428
Wrist, hand	1,060 (16.5)	19	1,374 (21.4)	25	627 (9.8)	11	1,672 (26.1)	30	4,636 (72.2)	85
Pelvis	567 (15.3)	10	983 (26.5)	18	822 (22.1)	15	934 (25.1)	17	2,986 (80.4)	54
Hip	2,601 (14.1)	47	5,108 (27.7)	93	5,094 (27.6)	93	4,815 (26.1)	88	14,673 (79.5)	268
Femur	332 (16.0)	6	546 (26.4)	10	368 (17.8)	7	569 (27.5)	10	1,639 (79.1)	30
Lower leg	860 (15.5)	16	1,190 (21.5)	22	480 (8.7)	9	1,478 (26.7)	27	3,924 (70.7)	72
Ankle	709 (15.0)	13	991 (20.9)	18	359 (7.6)	7	1,317 (27.8)	24	3,382 (71.4)	62
Foot	828 (18.4)	15	1,016 (22.5)	19	288 (6.4)	5	1,208 (26.8)	22	3,158 (70.0)	58
TBI	652 (15.4)	12	982 (23.2)	18	726 (17.2)	13	1,290 (30.5)	24	3,284 (77.6)	60
Sprain	1,822 (17.9)	33	2,401 (23.6)	44	716 (7.0)	13	2,733 (26.9)	50	7,295 (71.8)	133
Open wound	4,240 (16.3)	77	6,545 (25.1)	119	5,096 (19.5)	93	6,686 (25.6)	122	20,340 (78.0)	371

Note. COPD = Chronic Obstructive Pulmonary Disease. TBI = Traumatic Brain Injury. Sprain refers to sprains or strains of tendon or ligament, and tears of joint cartilage. Sex-specific rates were calculated with total number of female observations per chronic condition and injury type as the numerator, and the sum of Ontario's female population over the five years as the denominator. Rates were reported per 100,000 population. Percentages were calculated with the total number of female observations with each injury type and chronic condition as the numerator and the number of female observations with the same injury type as the denominator.

Table G2

Chronic Conditions in Male Patients at the Emergency Department by Injury Type (2010-2014)

Injury Type	Asthma		COPD		Dementia		Diabetes		Hypertension	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Fracture	4,152 (11.6)	95	10,749 (30.0)	246	4,970 (13.9)	114	12,117 (33.8)	277	26,268 (73.3)	600
Face/skull	220 (11.0)	5	524 (26.2)	12	287 (14.3)	7	673 (33.6)	15	1,481 (74.0)	34
Vertebral	257 (11.8)	6	622 (28.6)	14	321 (14.8)	7	711 (32.7)	16	1,610 (74.1)	37
Clavicle	105 (11.8)	2	287 (32.2)	7	124 (13.9)	3	261 (29.3)	6	641 (71.9)	15
Rib	749 (12.2)	17	1,846 (30.2)	42	599 (9.8)	14	2,044 (33.4)	47	4,410 (72.0)	72.0
Humerus	343 (11.7)	8	927 (31.6)	21	392 (13.4)	9	1,080 (36.8)	25	2,190 (74.6)	50
Forearm	496 (11.2)	11	1,120 (25.2)	26	355 (8.0)	8	1,377 (31.0)	31	3,100 (69.7)	71
Wrist/hand	382 (12.7)	9	807 (26.9)	18	284 (9.5)	6	939 (31.3)	21	2,129 (70.9)	49
Pelvis	114 (10.4)	3	367 (33.6)	8	205 (18.8)	5	367 (33.6)	8	813 (74.5)	19
Hip	881 (11.1)	20	2,805 (35.4)	64	7,174 (27.2)	73	2,622 (33.1)	60	6,058 (76.5)	138
Femur	89 (14.5)	2	207 (33.8)	5	90 (14.7)	2	220 (35.9)	5	474 (77.3)	11
Lower leg	237 (10.4)	5	578 (25.4)	13	136 (6.0)	3	868 (38.2)	20	1,643 (72.2)	38
Ankle	180 (10.2)	4	440 (24.9)	10	101 (5.7)	2	664 (37.6)	15	1,303 (73.7)	30
Foot	164 (12.0)	4	365 (26.6)	8	75 (5.5)	2	490 (35.7)	11	959 (69.9)	22
TBI	481 (11.0)	11	1,149 (26.3)	26	644 (14.8)	15	1,677 (38.4)	38	3,367 (77.2)	77
Sprain	747 (12.9)	17	1,574 (27.3)	36	427 (7.4)	10	2,041 (35.4)	47	4,193 (72.7)	96
Open wound	2,925 (12.7)	67	6,952 (30.1)	159	4,000 (17.3)	91	7,593 (32.9)	173	17,411 (75.4)	398

Note. COPD = Chronic Obstructive Pulmonary Disease. TBI = Traumatic Brain Injury. Sprain refers to sprains or strains of tendon or ligament, and tears of joint cartilage. Sex-specific rates were calculated with total number of male observations per chronic condition and injury type as the numerator, and the sum of Ontario's male population over the five years as the denominator. Rates were reported per 100,000 population. Percentages were calculated with the total number of male observations with each injury type and chronic condition as the numerator and the number of male observations with the same injury type as the denominator.

Table G3

Chronic Conditions in Patients with Fractures at the Emergency Department by Sex and Age Group (2010-2014)

Characteristic	Asthma		COPD		Dementia		Diabetes		Hypertension	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Total [a]	17,337 (14.3)	176	31,260 (25.7)	317	17,848 (14.7)	181	34,163 (28.1)	346	90,364 (74.3)	916
Sex [b]										
Female	13,185 (15.4)	240	20,511 (23.9)	374	12,878 (15.0)	235	22,046 (25.7)	402	64,096 (74.7)	1,169
Male	4,152 (11.6)	95	10,749 (30.0)	246	4,970 (13.9)	114	12,117 (33.8)	277	26,096 (73.3)	600
Age Group (years) [c]										
65-69	3,994 (14.8)	130	5,606 (20.7)	182	741 (2.7)	24	7,045 (26.1)	229	15,882 (58.8)	517
70-74	3,098 (15.0)	135	4,948 (24.0)	216	1,145 (5.6)	50	6,039 (29.3)	263	14,117 (68.5)	615
75-79	3,165 (15.1)	175	5,649 (27.0)	312	2,425 (11.6)	134	6,664 (31.8)	368	16,148 (77.0)	891
80-84	3,138 (14.2)	227	6,288 (28.4)	456	4,448 (20.1)	322	6,656 (30.1)	482	17,940 (81.1)	1,300
85-89	2,506 (13.5)	293	5,333 (28.6)	623	5,018 (26.9)	587	5,086 (27.3)	595	15,740 (84.5)	1,840
90+	1,436 (11.6)	176	3,436 (27.8)	770	4,071 (33.0)	912	2,673 (21.7)	599	10,537 (85.3)	2,361

Note. COPD = Chronic Obstructive Pulmonary Disease. [a] Crude rate was calculated with total number of fracture observations at the ED as the numerator and the sum of Ontario's population over the five years as the denominator. [b] Sex-specific rates were calculated with total number of observations per sex as the numerator and the sum of Ontario's population over the five years per sex as the denominator. [c] Age-specific rates were calculated with total number of observations per age group as the numerator, and the sum of Ontario's population over the five years per age group as the denominator. Rates were reported per 100,000. Percentages were calculated using the total number of FRI observations per sex or age group as the denominator; total N = 304,610, female N = 192,044, male N = 112,566 in males, N = 67,837 in 65-69 group, N = 51,958 in 70-74 group, N = 53,384 in 75-79 group, N = 56,008 in 80-84 group, N = 46,185 in 85-89 group, N = 29,238 in the 90+ group.

Table G4

Chronic Conditions in Patients with Hip Fractures by Demographic Characteristics at the Emergency Department (2010-2014)

Characteristic	Asthma		COPD		Dementia		Diabetes		Hypertension	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Total [a]	3,482 (13.2)	35	7,913 (30.0)	80	7,174 (27.2)	73	7,437 (28.2)	75	20,731 (78.6)	210
Sex [b]										
Female	2,601 (14.1)	47	5,108 (27.7)	93	5,094 (27.6)	93	4,815 (26.1)	88	14,673 (79.5)	268
Male	881 (11.1)	20	2,805 (35.4)	64	2,080 (26.3)	48	2,622 (33.1)	60	6,058 (76.5)	138
Age group (years) [c]										
65-69	326 (14.9)	11	673 (30.8)	22	169 (7.7)	6	634 (29.0)	21	1,319 (60.4)	43
70-74	378 (15.2)	16	796 (32.1)	35	320 (12.9)	14	813 (32.8)	35	1,724 (69.5)	75
75-79	588 (15.1)	32	1,233 (31.7)	68	776 (19.9)	43	1,293 (33.2)	71	2,995 (76.9)	165
80-84	812 (13.4)	59	1,840 (30.4)	133	1,824 (30.1)	132	1,814 (30.0)	131	4,838 (79.9)	351
85-89	803 (12.4)	94	1,892 (29.2)	221	2,153 (33.3)	252	1,778 (27.5)	208	5,398 (83.4)	631
90+	575 (10.9)	129	1,479 (28.0)	331	1,932 (36.6)	433	1,105 (20.9)	248	4,457 (84.4)	999

Note. COPD = Chronic Obstructive Pulmonary Disease. [a] Crude rate was calculated with total number of fracture observations at the ED as the numerator and the sum of Ontario's population over the five years as the denominator. [b] Sex-specific rates were calculated with total number of observations per sex as the numerator and the sum of Ontario's population over the five years per sex as the denominator. [c] Age-specific rates were calculated with total number of observations per age group as the numerator, and the sum of Ontario's population over the five years per age group as the denominator. Rates were reported per 100,000. Percentages were calculated using the total number of FRI observations per sex or age group as the denominator.

Table G5

Comorbidities by Injury Type and Demographic Characteristics among Patients in Hospital (2010-2016)

	Asthma		COPD		Dementia		Diabetes		Hypertension	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Total [a]	23,176 (16.2)	235	46,338 (32.4)	470	29,303 (20.5)	297	48,449 (33.8)	491	116,475 (81.3)	1,181
Sex [b]										
Female	15,644 (17.9)	285	26,465 (30.2)	483	18,455 (21.1)	337	27,052 (30.9)	493	72,024 (82.2)	1,314
Male	7,532 (13.5)	172	19,873 (35.7)	454	10,848 (19.5)	248	21,397 (38.5)	489	44,451 (80.0)	1,015
Age group [c]										
65-69	3,908 (18.2)	127	6,474 (30.2)	211	1,205 (5.6)	39	7,725 (36.0)	251	14,780 (69.0)	481
70-74	3,592 (18.3)	157	6,405 (32.6)	279	1,892 (9.6)	82	7,391 (37.6)	322	14,953 (76.0)	652
75-79	4,197 (17.2)	232	8,249 (33.8)	455	4,009 (16.4)	221	9,363 (38.4)	517	19,960 (81.8)	1,102
80-84	4,816 (16.0)	349	10,138 (33.6)	735	7,428 (24.6)	538	10,577 (35.0)	767	25,505 (84.5)	1,848
85-89	4,161 (14.8)	486	9,129 (32.5)	1,067	8,312 (29.6)	972	8,664 (30.9)	1,013	24,309 (86.6)	2,842
90+	2,502 (12.8)	561	5,943 (30.5)	1,332	6,457 (33.2)	1,447	4,729 (24.3)	1,060	16,968 (87.1)	3,802

Note. COPD = Chronic Obstructive Pulmonary Disease. [a] Crude rate was calculated with total number of fracture observations at the hospital as the numerator and the sum of Ontario's population over the five years as the denominator. [b] Sex-specific rates were calculated with total number of observations per sex as the numerator and the sum of Ontario's population over the five years per sex as the denominator. [c] Age-specific rates were calculated with total number of observations per age group as the numerator, and the sum of Ontario's population over the five years per age group as the denominator. Rates were reported per 100,000. Percentages were calculated using the total number of FRI observations per sex or age group as the denominator.

Table G6

Comorbidities by Injury Type and Demographic Characteristics among Patients with Fractures at the Hospital (2010-2014)

	Asthma		COPD		Dementia		Diabetes		Hypertension	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Total [a]	10,336 (14.9)	105	20,902 (30.1)	212	13,633 (19.7)	138	21,094 (30.4)	214	54,732 (78.9)	555
Sex [b]										
Female	7,718 (16.2)	141	13,476 (28.2)	246	9,648 (20.2)	176	13,400 (28.0)	244	38,112 (79.8)	695
Male	2,618 (12.1)	60	7,426 (34.4)	170	3,985 (18.5)	91	7,694 (35.6)	176	16,620 (77.0)	380
Age group [c]										
65-69	1,735 (16.4)	56	2,937 (27.8)	96	482 (4.6)	16	3,320 (31.4)	108	6,878 (65.1)	224
70-74	1,576 (16.9)	69	2,829 (30.4)	123	768 (8.2)	33	3,154 (33.8)	137	6,770 (72.6)	295
75-79	1,902 (16.5)	105	3,645 (31.5)	201	1,729 (15.0)	95	4,069 (35.2)	225	9,151 (79.1)	505
80-84	2,119 (14.7)	154	4,528 (31.5)	328	3,440 (23.9)	249	4,567 (31.8)	331	11,851 (82.4)	859
85-89	1,866 (13.7))	218	4,148 (30.4)	485	3,918 (28.8)	458	3,835 (28.1)	448	11,563 (84.9)	1,352
90+	1,138 (11.5)	255	2,815 (28.4)	631	3,296 (33.2)	739	2,149 (21.7)	482	8,519 (85.8)	1,909

Note. COPD = Chronic Obstructive Pulmonary Disease. [a] Crude rate was calculated with total number of fracture observations at the hospital as the numerator and the sum of Ontario's population over the five years as the denominator. [b] Sex-specific rates were calculated with total number of observations per sex as the numerator and the sum of Ontario's population over the five years per sex as the denominator. [c] Age-specific rates were calculated with total number of observations per age group as the numerator, and the sum of Ontario's population over the five years per age group as the denominator. Rates were reported per 100,000. Percentages were calculated using the total number of FRI observations per sex or age group as the denominator.

Appendix H. Types of Falls at the Emergency Department and Hospital Levels of Care

Table H1

Female Patents with Codes for Fall Types at the Emergency Department (2010-2014)

Fall type	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Slip, trip stumble	14,861 (36.2)	930	11,629 (36.9)	950	12,174 (37.2)	1,227	12,897 (36.8)	1,613	10,556 (34.4)	1,929	6,290 (30.0)	1,952
Unspecified	7,485 (18.2)	469	6,009 (19.1)	491	6,820 (20.8)	687	7,936 (22.6)	992	7,804 (25.5)	1,426	6,191 (29.5)	1,922
Other same level	4,896 (11.9)	307	4,073 (12.9)	333	4,777 (14.6)	481	5,600 (16.0)	700	5,406 (17.6)	988	3,937 (18.8)	1,222
Stairs, steps	6,380 (15.5)	399	4,670 (14.8)	382	4,267 (13.0)	430	3,745 (10.7)	468	2,390 (7.8)	437	1,021 (4.9)	317
Snow, ice	3,549 (8.6)	222	2,241 (7.1)	183	1,593 (4.9)	160	1,117 (3.2)	140	594 (1.9)	109	149 (0.7)	46
Bed	649 (1.6)	41	647 (2.1)	53	903 (2.8)	91	1,253 (3.6)	157	1,355 (4.4)	248	1,261 (6.0)	391
Chair	681 (1.7)	43	549 (1.7)	45	671 (2.0)	68	742 (2.1)	93	697 (2.3)	127	488 (2.3)	151
Walker	209 (0.5)	13	240 (0.8)	20	349 (1.1)	35	641 (1.9)	80	886 (2.9)	162	885 (4.2)	275
One level to other	772 (1.9)	48	511 (1.6)	42	388 (1.2)	39	324 (0.9)	41	272 (0.9)	50	133 (0.6)	41
Wheelchair	229 (0.6)	14	180 (0.6)	15	237 (0.7)	24	296 (0.8)	37	362 (1.2)	66	420 (2.0)	130
Ladder	537 (1.3)	34	320 (1.0)	26	202 (0.6)	20	143 (0.4)	18	73 (0.2)	13	14 (0.1)	4

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Stairs, steps = 'Fall on and from stairs and steps' (W10). Snow, ice = 'Fall on same level involving ice and snow' (W00). Bed = 'Fall involving bed' (W06). Chair = 'Fall involving chair' (W07). Walker = 'Fall involving adult walker' (W0501). One level to other = 'Other fall from one level to another' (W17). Wheelchair = 'Fall involving wheelchair' (W0500). Ladder = 'Fall on and from ladder' (W11). Age-specific rates were calculated with total number of observations among females per age group as the numerator, and the sum of Ontario's female population over the five years per age group as the denominator. Reported per 100,000 population. Percentages calculated with the number of FRI observations in females per age group as the denominator.

Table H2

Male Patients with Codes for Fall Types at the Emergency Department (2010-2014)

Fall type	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Slip, trip stumble	7,040 (26.3)	477	5,809 (28.5)	542	6,371 (30.9)	778	6,645 (31.7)	1,146	4,948 (31.9)	1,606	2,450 (29.6)	1,975
Unspecified	4,688 (17.5)	318	2,207 (18.5)	352	4,119 (20.0)	503	4,663 (22.2)	804	3,867 (24.9)	1,255	2,207 (26.7)	1,779
Other same level	3,252 (12.2)	220	2,657 (13.0)	248	2,892 (14.0)	353	3,334 (15.9)	575	2,611 (16.8)	848	1,574 (19.0)	1,269
Stairs, steps	3,315 (12.4)	225	2,506 (12.3)	234	2,413 (11.7)	295	2,214 (10.6)	382	1,378 (8.9)	447	529 (6.4)	426
Snow, ice	2,956 (11.1)	200	2,036 (10.1)	190	1,678 (8.1)	205	1,246 (5.9)	215	625 (4.0)	203	201 (2.4)	162
Ladder	2,204 (8.2)	149	1,305 (6.4)	122	928 (4.5)	113	496 (2.4)	86	160 (1.0)	52	54 (0.7)	44
Bed	514 (1.9)	35	523 (2.6)	49	629 (3.0)	77	769 (3.5)	133	711 (4.6)	231	462 (5.6)	372
One level to other	1.031 (3.9)	70	596 (2.9)	56	437 (2.1)	53	322 (1.5)	56	173 (1.1)	56	62 (0.7)	50
Chair	353 (1.3)	24	353 (1.7)	33	384 (1.9)	47	440 (2.1)	76	357 (2.3)	116	230 (2.8)	185
Wheelchair	259 (1.0)	18	169 (0.8)	16	213 (1.0)	26	274 (1.3)	47	241 (1.6)	78	168 (2.0)	135
Walker	93 (0.3)	6	113 (0.6)	11	179 (0.9)	22	298 (1.4)	51	317 (2.0)	103	263 (3.2)	212

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Stairs, steps = 'Fall on and from stairs and steps' (W10). Snow, ice = 'Fall on same level involving ice and snow' (W00). Ladder = 'Fall on and from ladder' (W11). Bed = 'Fall involving bed' (W06). One level to other = 'Other fall from one level to another' (W17). Chair = 'Fall involving chair' (W07). Wheelchair = 'Fall involving wheelchair' (W0500). Walker = 'Fall involving adult walker' (W0501). Age-specific rates were calculated with total number of observations among males per age group as the numerator, and the sum of Ontario's male population over the five years per age group as the denominator. Reported per 100,000 population. Percentages calculated with the number of FRI observations in males per age group as the denominator.

Table H3

Types of Falls seen in Female Patients with Fractures at the Emergency Department by Age Group (2010-2014)

Fall type	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Slip, trip, stumble	6,765 (36.6)	424	5,296 (37.6)	433	5,552 (38.4)	559	5,909 (37.9)	739	4,975 (36.4)	909	3,037 (31.8)	943
Unspecified	3,237 (17.5)	203	2,649 (18.8)	216	2,885 (19.9)	291	3,484 (22.3)	436	3,415 (25.0)	624	2,802 (29.3)	870
Other same level	2,047 (11.1)	128	1,629 (11.6)	133	1,965 (13.6)	198	2,305 (14.8)	288	2,318 (16.9)	424	1,819 (19.1)	565
Stairs, steps	2,864 (15.5)	179	2.090 (14.8)	171	1,931 (13.3)	195	1,701 (10.9)	213	1,091 (8.0)	199	472 (4.9)	146
Snow, ice	1,923 (10.4)	120	1,240 (8.8)	101	903 (6.2)	91	653 (4.2)	82	356 (2.6)	65	72 (0.8)	22
Chair	259 (1.4)	16	237 (1.7)	19	273 (1.9)	28	335 (2.1)	42	289 (2.1)	53	207 (2.2)	64
Bed	211 (1.1)	13	208 (1.5)	17	313 (2.2)	32	495 (3.2)	62	493 (3.6)	90	478 (5.0)	148
Ladder	259 (1.4)	16	144 (1.0)	12	96 (0.7)	10	71 (0.5)	9	35 (0.3)	6	8 (0.1)	2
Walker	72 (0.4)	5	85 (0.6)	7	134 (0.9)	14	255 (1.6)	32	376 (2.7)	69	398 (4.2)	124
Wheelchair	84 (0.5)	5	70 (0.5)	6	74 (0.5)	7	103 (0.7)	13	109 (0.8)	20	135 (1.4)	42

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Stairs, steps = 'Fall on and from stairs and steps' (W10). Snow, ice = 'Fall on same level involving ice and snow' (W00). Chair = 'Fall involving chair' (W07). Bed = 'Fall involving bed' (W06). Ladder = 'Fall on and from ladder' (W11). Walker = 'Fall involving adult walker' (W0501). Wheelchair = 'Fall involving wheelchair' (W0500). Walker = 'Fall involving adult walker' (W0501). Age-specific rates were calculated with total number of fracture observations among females per age group as the numerator, and the sum of Ontario's female population over the five years per age group as the denominator. Reported per 100,000 population. Percentages calculated with the number of fracture observations in females per age group as the denominator.

Table H4

Types of Falls seen in Male Patients with Fractures at the Emergency Department by Age Group (2010-2014)

Fall type	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Slip, trip, stumble	2,104 (24.6)	143	1,787 (27.4)	167	1,988 (30.7)	243	2,061 (31.6)	355	1,562 (31.6)	507	842 (30.1)	679
Unspecified	1,494 (17.5)	101	1,150 (17.6)	107	1,295 (20.0)	158	1,425 (21.9)	246	1,271 (25.7)	413	758 (27.1)	611
Other same level	892 (10.4)	60	748 (11.5)	70	830 (12.8)	101	953 (14.6)	164	770 (15.6)	250	527 (18.8)	425
Stairs, steps	1,074 (12.6)	73	859 (13.2)	80	756 (11.7)	92	707 (10.8)	122	475 (9.6)	154	187 (6.7)	151
Snow, ice	986 (11.5)	67	777 (11.9)	73	620 (9.6)	76	482 (7.4)	83	255 (5.2)	83	89 (3.2)	72
Chair	85 (1.0)	6	104 (1.6)	10	109 (1.7)	13	138 (2.1)	24	105 (2.1)	34	73 (2.6)	59
Bed	103 (1.2)	7	96 (1.5)	9	142 (2.2)	17	184 (2.8)	32	182 (3.7)	59	129 (4.6)	104
Ladder	955 (11.2)	65	527 (8.1)	49	359 (5.5)	44	190 (2.9)	33	67 (1.4)	22	22 (0.8)	18
Walker	35 (0.4)	2	44 (0.7)	4	54 (0.8)	7	106 (1.6)	18	107 (2.2)	35	89 (3.2)	72
Wheelchair	78 (0.9)	5	50 (0.8)	5	53 (0.8)	6	73 (1.1)	13	54 (1.1)	18	39 (1.4)	31

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Stairs, steps = 'Fall on and from stairs and steps' (W10). Snow, ice = 'Fall on same level involving ice and snow' (W00). Chair = 'Fall involving chair' (W07). Bed = 'Fall involving bed' (W06). Ladder = 'Fall on and from ladder' (W11). Walker = 'Fall involving adult walker' (W0501). Wheelchair = 'Fall involving wheelchair' (W0500). Age-specific rates were calculated with total number of fracture observations among males per age group as the numerator, and the sum of Ontario's male population over the five years per age group as the denominator. Reported per 100,000 population. Percentages calculated with the number of fracture observations in males per age group as the denominator.

Table H5

Female Patients with Hip Fractures by Fall Type at the Emergency Department (2010-2014)

Fall type	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Slip, trip, stumble	547 (40.0)	34	622 (39.5)	51	1,016 (38.7)	102	1,579 (37.8)	197	1,789 (38.3)	327	1,302 (32.3)	404
Unspecified	241 (17.6)	15	313 (19.9)	26	558 (21.2)	56	958 (22.9)	120	1,132 (24.2)	207	1,148 (28.5)	356
Other same level	212 (15.5)	13	240 (15.2)	20	466 (17.7)	47	758 (18.1)	95	846 (18.1)	155	822 (20.4)	255
Stairs, steps	116 (8.5)	7	153 (9.7)	13	215 (8.2)	22	295 (7.1)	37	234 (5.0)	43	141 (3.5)	44
Bed	31 (2.3)	2	42 (2.7)	3	81 (3.1)	8	163 (3.9)	20	198 (4.2)	36	197 (4.9)	61
Walker	22 (1.6)	1	28 (1.8)	2	52 (2.0)	5	98 (2.3)	12	165 (3.5)	30	179 (4.4)	56
Snow, ice	93 (6.8)	6	84 (5.3)	7	103 (3.9)	10	103 (2.5)	13	82 (1.8)	15	19 (0.5)	6
Chair	26 (1.9)	2	33 (2.1)	3	52 (2.0)	5	104 (2.5)	13	112 (2.4)	20	109 (2.7)	34
Wheelchair	17 (1.2)	1	20 (1.3)	2	21 (0.8)	2	41 (1.0)	5	39 (0.8)	7	63 (1.6)	20

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Stairs, steps = 'Fall on and from stairs and steps' (W10). Bed = 'Fall involving bed' (W06). Walker = 'Fall involving adult walker' (W0501). Snow, ice = 'Fall on same level involving ice and snow' (W00). Chair = 'Fall involving chair' (W07). Wheelchair = 'Fall involving wheelchair' (W0500). Age-specific rates were calculated with total number of female observations with hip fractures per fall type and age group as the numerator, and the sum of Ontario's female population over the five years per age group as the denominator; reported per 100,000 population. Percentages were calculated with the number of patients with hip fractures per age group as the denominator.

Table H6

Male Patients with Hip Fractures by Fall Type at the Emergency Department (2010-2014)

Fall type	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Slip, trip, stumble	222 (27.2)	15	279 (30.8)	26	409 (32.3)	50	647 (34.5)	112	589 (32.8)	191	403 (32.2)	325
Unspecified	161 (19.7)	11	175 (19.3)	16	282 (22.2)	34	422 (22.5)	73	478 (26.6)	155	325 (26.0)	262
Other same level	121 (14.8)	8	142 (15.7)	13	198 (15.6)	24	313 (16.7)	54	311 (17.3)	101	261 (20.9)	210
Stairs, steps	70 (8.6)	5	83 (9.2)	8	106 (8.4)	13	120 (6.4)	21	99 (5.5)	32	42 (3.4)	34
Snow, ice	78 (9.5)	5	87 (9.6)	8	94 (7.4)	11	94 (5.0)	16	69 (3.8)	22	27 (2.2)	22
Chair	15 (1.8)	1	24 (2.6)	2	24 (1.9)	3	44 (2.3)	8	46 (2.6)	15	31 (2.5)	25
Bed	23 (2.8)	2	18 (2.0)	2	55 (4.3)	7	79 (4.2)	14	76 (4.2)	25	67 (5.4)	54
Wheelchair	25 (3.1)	2	13 (1.4)	1	17 (1.3)	2	38 (2.0)	7	27 (1.5)	9	20 (1.6)	16
Walker	13 (1.6)	1	15 (1.7)	1	18 (1.4)	2	50 (2.7)	9	58 (3.2)	19	52 (4.2)	42
Ladder	39 (4.8)	3	30 (3.3)	3	28 (2.2)	3	23 (1.2)	4	≤ 10	N/A	≤ 5	N/A

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Stairs, steps = 'Fall on and from stairs and steps' (W10). Snow, ice = 'Fall on same level involving ice and snow' (W00). Chair = 'Fall involving chair' (W07). Bed = 'Fall involving bed' (W06). Wheelchair = 'Fall involving wheelchair' (W0500). Walker = 'Fall involving adult walker' (W0501). Ladder = 'Fall on and from ladder' (W11). Age-specific rates were calculated with total number of male observations with hip fractures per fall type and age group as the numerator, and the sum of Ontario's male population over the five years per age group as the denominator; reported per 100,000 population. Percentages were calculated with the number of patients with hip fractures per age group as the denominator.

Table H7

Fall Types in Patients with Wrist and Hand Fractures at the Emergency Department by Sex (2010-2014)

Fall type	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Female												
Slip, trip, stumble	784 (42.2)	49	553 (42.4)	45	466 (41.1)	47	433 (42.2)	54	307 (42.8)	56	121 (32.0)	38
Unspecified	417 (22.4)	26	305 (23.4)	25	273 (24.1)	28	246 (24.0)	31	162 (22.6)	30	121 (32.0)	38
Other same level	208 (11.2)	13	159 (12.2)	13	155 (13.7)	16	138 (13.5)	17	97 (13.5)	18	62 (16.4)	19
Stairs, steps	199 (10.7)	12	131 (10.0)	11	138 (12.2)	14	109 (10.6)	14	78 (10.9)	14	25 (6.6)	8
Male												
Slip, trip, stumble	260 (30.3)	18	198 (31.5)	18	217 (37.5)	26	185 (37.5)	32	125 (38.0)	41	38 (33.0)	31
Unspecified	214 (24.9)	15	140 (22.3)	13	141 (24.4)	17	113 (22.9)	19	93 (28.3)	30	33 (28.7)	27
Other same level	100 (11.7)	7	89 (14.2)	8	65 (11.2)	8	60 (12.2)	10	47 (14.3)	15	15 (13.0)	12
Stairs, steps	72 (8.4)	5	69 (11.0)	6	43 (7.4)	5	58 (11.8)	10	36 (10.9)	12	12 (10.4)	10

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Stairs, steps = 'Fall on and from stairs and steps' (W10). Age-specific rates were calculated with total number of observations with wrist and hand fractures per fall type, sex, and age group as the numerator, and the sum of Ontario's population per sex and age group over the five years as the denominator; reported per 100,000 population. Percentages were calculated with the number of patients with wrist and hand fractures per age group as the denominator.

Table H8

Fall Types in Patients with Forearm Fractures at the Emergency Department by Sex (2010-2014)

Fall type	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Female												
Slip, trip, stumble	2,023 (35.4)	127	1,484 (37.6)	121	1,369 (39.9)	138	1,255 (39.5)	157	868 (38.8)	159	406 (33.4)	126
Unspecified	1,119 (19.6)	70	793 (20.1)	65	674 (19.6)	68	721 (22.7)	90	528 (23.6)	96	366 (30.1)	114
Other same level	690 (12.1)	43	488 (12.3)	40	436 (12.7)	44	438 (13.8)	55	359 (16.1)	66	225 (18.5)	70
Stairs, steps	593 (10.4)	37	436 (11.0)	36	395 (11.5)	40	349 (11.0)	44	191 (8.5)	35	78 (6.4)	24
Snow, ice	855 (14.9)	54	476 (12.0)	39	328 (9.6)	33	207 (6.5)	26	106 (4.7)	19	20 (1.6)	6
Male												
Slip, trip, stumble	332 (23.2)	23	266 (26.9)	25	262 (32.0)	32	216 (35.4)	37	137 (33.3)	44	62 (32.6)	50
Unspecified	271 (19.0)	18	195 (19.7)	18	168 (20.5)	21	133 (21.8)	23	100 (24.3)	32	55 (28.9)	44
Other same level	149 (10.4)	10	101 (10.2)	9	90 (11.0)	11	76 (12.5)	13	67 (16.3)	22	23 (12.1)	19
Stairs, steps	139 (9.7)	9	107 (10.8)	10	76 (9.3)	9	65 (10.7)	11	41 (10.0)	13	20 (10.5)	16
Snow, ice	213 (14.9)	14	156 (15.8)	15	117 (14.3)	14	72 (11.8)	12	31 (7.5)	10	13 (6.8)	10

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Stairs, steps = 'Fall on and from stairs and steps' (W10). Snow, ice = 'Fall on same level involving ice and snow' (W00). Age-specific rates were calculated with total number of observations with forearm fractures per fall type, sex, and age group as the numerator, and the sum of Ontario's population per sex and age group over the five years as the denominator; reported per 100,000 population. Percentages were calculated with the number of patients with forearm fractures per age group as the denominator.

Table H9

Fall Types in Patients with Humerus Fractures at the Emergency Department by Sex (2010-2014)

Fall type	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Female												
Slip, trip, stumble	961 (42.1)	60	762 (42.1)	62	819 (42.7)	83	780 (41.0)	98	628 (41.1)	115	291 (34.0)	90
Unspecified	354 (15.5)	22	287 (15.9)	23	331 (17.2)	33	350 (18.4)	44	352 (23.0)	64	222 (25.9)	69
Other same level	252 (11.0)	16	197 (10.9)	16	216 (11.3)	22	259 (13.6)	32	220 (14.4)	40	155 (18.1)	48
Stairs, steps	273 (11.9)	17	229 (12.7)	19	249 (13.0)	25	230 (12.1)	29	133 (8.7)	24	65 (7.6)	20
Snow, ice	257 (11.2)	16	176 (9.7)	14	138 (7.2)	14	102 (5.4)	13	54 (3.5)	10	9 (1.1)	3
Male												
Slip, trip, stumble	200 (29.8)	14	167 (32.9)	16	199 (34.9)	24	198 (34.4)	34	127 (31.4)	41	66 (32.2)	53
Unspecified	113 (16.8)	8	86 (17.0)	8	100 (17.5)	12	111 (19.3)	19	95 (23.5)	31	44 (21.5)	35
Other same level	64 (9.5)	4	52 (10.3)	5	75 (13.1)	9	69 (12.0)	12	50 (12.3)	16	39 (19.0)	31
Stairs, steps	73 (10.9)	5	55 (10.8)	5	62 (10.9)	8	73 (12.7)	13	50 (12.3)	16	14 (6.8)	11
Snow, ice	99 (14.7)	7	77 (15.2)	7	66 (11.6)	8	60 (10.4)	10	37 (9.1)	12	12 (5.9)	10

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Stairs, steps = 'Fall on and from stairs and steps' (W10). Snow, ice = 'Fall on same level involving ice and snow' (W00). Age-specific rates were calculated with total number of observations with humerus fractures per fall type, sex, and age group as the numerator, and the sum of Ontario's population per sex and age group over the five years as the denominator; reported per 100,000 population. Percentages were calculated with the number of patients with humerus fractures per age group as the denominator.

Table H10

Female Patients with Open Wounds by Fall Type at the Emergency Department (2010-2014)

Fall type	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Slip, trip, stumble	1,641 (41.5)	103	1,554 (42.7)	127	1,902 (43.5)	192	2,259 (42.7)	282	2,017 (39.9)	369	1,241 (33.0)	385
Unspecified	579 (14.6)	36	521 (14.3)	43	681 (15.6)	69	905 (17.1)	113	998 (19.7)	182	910 (24.2)	282
Other same level	586 (14.8)	37	560 (15.4)	46	682 (15.6)	69	847 (16.0)	106	822 (16.3)	150	665 (17.7)	206
Stairs, steps	564 (14.3)	35	548 (15.0)	45	573 (13.1)	58	621 (11.8)	78	459 (9.1)	84	233 (6.2)	72
Snow, ice	189 (4.8)	12	115 (3.2)	9	101 (2.3)	10	93 (1.8)	12	63 (1.2)	12	17 (0.5)	5
Chair	62 (1.6)	4	59 (1.6)	5	82 (1.9)	8	94 (1.8)	12	109 (2.2)	20	103 (2.7)	32
Bed	90 (2.3)	6	103 (2.8)	8	147 (3.4)	15	189 (3.6)	24	227 (4.5)	41	234 (6.2)	73
Wheelchair	25 (0.6)	2	28 (0.8)	2	46 (1.1)	5	60 (1.1)	8	109 (2.2)	20	132 (3.5)	41
Walker	25 (0.6)	2	36 (1.0)	3	48 (1.1)	5	98 (1.9)	12	150 (3.0)	27	158 (4.2)	49

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Stairs, steps = 'Fall on and from stairs and steps' (W10). Snow, ice = 'Fall on same level involving ice and snow' (W00). Chair = 'Fall involving chair' (W07). Bed = 'Fall involving bed' (W06). Wheelchair = 'Fall involving wheelchair' (W0500). Walker = 'Fall involving adult walker' (W0501). Age-specific rates were calculated with total number of female observations with open wounds per fall type and age group as the numerator, and the sum of Ontario's female population over the five years per age group as the denominator; reported per 100,000 population. Percentages were calculated with the number of patients with hip fractures per age group as the denominator. Falls from ladders were not included as counts were ≤5 in at least one age group.

Table H11

Male Patients with Open Wounds by Fall Type at the Emergency Department (2010-2014)

Fall type	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Slip, trip, stumble	1,473 (32.8)	100	1,263 (34.2)	118	1,574 (37.3)	192	1,802 (37.3)	311	1,404 (37.7)	456	737 (34.7)	594
Unspecified	690 (15.4)	47	621 (16.8)	58	686 (16.3)	84	830 (17.2)	143	715 (19.2)	232	458 (21.5)	369
Other same level	694 (15.5)	47	539 (14.6)	50	646 (15.3)	79	821 (17.0)	142	659 (17.7)	214	391 (18.4)	315
Stairs, steps	459 (10.2)	31	398 (10.8)	37	456 (10.8)	56	541 (11.2)	93	345 (9.3)	112	153 (7.2)	123
Bed	174 (3.9)	12	153 (4.1)	14	188 (4.5)	23	218 (4.5)	38	206 (5.5)	67	134 (6.3)	108
Snow, ice	270 (6.0)	18	206 (5.6)	19	183 (4.3)	22	171 (3.5)	29	84 (2.3)	27	32 (1.5)	26
Ladder	314 (7.0)	21	220 (6.0)	21	169 (4.0)	21	83 (1.7)	14	27 (0.7)	9	8 (0.4)	6
Chair	63 (1.4)	4	67 (1.8)	6	94 (2.2)	11	101 (2.1)	17	81 (2.2)	26	54 (2.5)	44
Wheelchair	65 (1.4)	4	30 (0.8)	3	52 (1.2)	6	74 (1.5)	13	70 (1.9)	23	57 (2.7)	46
Walker	14 (0.3)	1	22 (0.6)	2	33 (0.8)	4	65 (1.3)	11	69 (1.9)	22	69 (3.2)	56

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Stairs, steps = 'Fall on and from stairs and steps' (W10). Bed = 'Fall involving bed' (W06). Snow, ice = 'Fall on same level involving ice and snow' (W00). Ladder = 'Fall on and from ladder' (W11). Chair = 'Fall involving chair' (W07). Wheelchair = 'Fall involving wheelchair' (W0500). Walker = 'Fall involving adult walker' (W0501). Age-specific rates were calculated with total number of male observations with open wounds per fall type and age group as the numerator, and the sum of Ontario's male population over the five years per age group as the denominator; reported per 100,000 population. Percentages were calculated with the number of patients with hip fractures per age group as the denominator.

Table H12

Most Common Fall Types in Patients with Sprains, Strains, or Tear of Tendons, Ligaments, or Joint Cartilage at the Emergency Department by Sex (2010-2014)

Fall type	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Female												
Slip, trip, stumble	1,321 (35.9)	83	769 (36.0)	63	600 (35.3)	60	487 (36.1)	61	295 (35.0)	54	139 (30.5)	43
Unspecified	646 (17.6)	40	379 (17.8)	31	354 (20.8)	36	319 (23.7)	40	249 (29.6)	45	119 (26.1)	37
Stairs, steps	781 (21.2)	49	433 (20.3)	35	285 (16.8)	29	189 (14.0)	24	69 (8.2)	13	39 (8.6)	12
Other same level	326 (8.9)	20	240 (11.2)	20	214 (12.6)	22	166 (12.3)	21	124 (14.7)	23	83 (18.2)	26
Snow, ice	287 (7.8)	18	149 (7.0)	12	87 (5.1)	9	54 (4.0)	7	22 (2.6)	4	8 (1.8)	2
Male												
Slip, trip, stumble	592 (29.4)	40	394 (30.8)	37	302 (29.7)	37	257 (31.7)	44	143 (30.4)	46	53 (29.9)	43
Unspecified	298 (14.8)	20	224 (17.5)	21	216 (21.2)	26	165 (20.4)	28	122 (25.9)	40	52 (29.4)	42
Stairs, steps	290 (14.4)	20	182 (14.2)	17	129 (12.7)	16	103 (12.7)	18	53 (11.3)	17	14 (7.9)	11
Other same level	183 (9.1)	12	121 (9.5)	11	109 (10.7)	13	102 (12.6)	18	67 (14.2)	22	30 (16.9)	24

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Stairs, steps = 'Fall on and from stairs and steps' (W10). Other same level = 'Other fall on same level' (W18). Snow, ice = 'Fall on same level involving ice and snow' (W00). Age-specific rates were calculated with total number of observations with sprains, strains, and tears per fall type, sex, and age group as the numerator, and the sum of Ontario's population per sex and age group over the five years as the denominator; reported per 100,000 population. Percentages were calculated with the number of patients with humerus fractures per age group as the denominator. Snow and ice falls were excluded for males from this table as at least one age group had ≤5 observations.

Table H13
Fall Types in Female Patients with all Fall-Related Injuries at the Hospital (2010-2014)

Fall type	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Slip, trip, stumble	4,126 (34.3)	258	3,762 (33.6)	307	4,902 (34.3)	494	6,160 (33.8)	770	5,907 (32.5)	1,079	3,967 (28.9)	1,231
Unspecified	2,362 (19.6)	148	2,276 (20.3)	186	3,147 (22.0)	317	4,420 (24.3)	553	4,805 (26.5)	878	4,160 (30.3)	1,291
Other same level	1,626 (13.5)	148	1,680 (15.0)	186	2,388 (16.7)	317	3,182 (17.5)	553	3,412 (18.8)	878	2,684 (19.6)	1,291
Stairs, steps	1,749 (14.5)	109	1,635 (14.6)	134	1,711 (12.0)	172	1,760 (9.7)	220	1,247 (6.9)	228	641 (4.7)	199
Bed	304 (2.5)	19	334 (3.0)	27	523 (3.7)	53	802 (4.4)	100	867 (4.8)	158	789 (5.7)	245
Snow, Ice	824 (6.8)	52	640 (5.7)	52	536 (3.8)	54	459 (2.5)	57	289 (1.6)	53	83 (0.6)	26
Chair	208 (1.7)	13	217 (1.9)	18	288 (2.0)	29	397 (2.2)	50	413 (2.3)	75	303 (2.2)	94

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Stairs, steps = 'Fall on and from stairs and steps' (W10). Bed = 'Fall involving bed' (W06). Snow, ice = 'Fall on same level involving ice and snow' (W00). Chair = 'Fall involving chair' (W07). Age-specific rates are calculated with total number of observations per characteristic as the numerator, and the sum of Ontario's population over the five years per characteristic as the denominator; reported per 100,000 population.

Table H14

Fall Types in Male Patients with all Fall-Related Injuries at the Hospital (2010-2014)

Fall type	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Slip, trip stumble	2,370 (25.2)	161	2,297 (27.1)	214	2,894 (28.6)	353	3,496 (29.2)	603	2,877 (29.1)	934	1,625 (28.2)	1,310
Unspecified	1,897 (20.2)	129	1,666 (19.7)	156	2,243 (22.2)	274	2,901 (24.2)	500	2,648 (26.8)	860	1,590 (27.6)	1,282
Other same level	1,340 (14.2)	91	1,285 (15.2)	120	1,595 (15.8)	195	2,146 (17.9)	370	1,766 (17.8)	573	1,156 (20.1)	932
Stairs, steps	1,137 (12.1)	77	1,032 (12.2)	96	1,196 (11.8)	146	1,151 (9.6)	198	817 (8.3)	265	340 (5.9)	274
Snow, ice	771 (8.2)	52	649 (7.7)	61	617 (6.1)	75	540 (4.5)	93	333 (3.4)	108	115 (2.0)	93
Bed	265 (2.8)	18	272 (3.2)	25	354 (3.5)	43	505 (4.2)	87	519 (5.2)	168	343 (6.0)	276
Ladder	663 (7.1)	45	438 (5.2)	41	366 (3.6)	45	227 (1.9)	39	84 (0.8)	27	27 (0.5)	22

Note. Slip, trip, stumble = 'Fall on same level from slipping, tripping, and stumbling' (W01). Unspecified = 'Unspecified fall' (W19). Other same level = 'Other fall on same level' (W18). Stairs, steps = 'Fall on and from stairs and steps' (W10). Snow, ice = 'Fall on same level involving ice and snow' (W00). Bed = 'Fall involving bed' (W06). Ladder = 'Fall on and from ladder' (W11). Age-specific rates are calculated with total number of observations per characteristic as the numerator, and the sum of Ontario's population over the five years per characteristic as the denominator; reported per 100,000 population. Data from the Discharge Abstract Database dataset.

Appendix G. Emergency Department Results for Fall-Related Injuries

Table I1
Injury Type per Local Health Integration Network (2010-2014)

LHIN	Fracture		Superficial		Open wound		Sprain		TBI		Dislocation		One-year mortality	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
1. Erie St. Clair	6,831	41.7	4,660	28.5	2,889	17.7	678	4.1	481	2.9	364	2.2	2,177	13.3
2. South West	10,503	39.3	7,803	29.2	4,361	16.3	1,692	6.3	694	2.6	573	2.1	2,897	10.8
3. Waterloo	6,043	40.5	3,557	23.8	2,769	18.5	703	4.7	382	2.6	315	2.1	1,723	11.5
4. Hamilton Niagara	15,345	39.7	9,051	23.4	6,458	16.7	1,737	4.5	1,085	2.8	785	2.0	4,612	11.9
5. Central West	5,202	42.6	2,017	16.5	1,831	15.0	529	4.3	341	2.8	332	2.7	1,216	10.0
6. Mississauga Halton	8,089	40.9	4,139	20.9	3,044	15.4	1,095	5.5	595	3.0	422	2.1	1,894	9.6
7. Toronto Central	10,296	42.4	4,236	17.4	4,168	17.2	897	3.7	656	2.7	573	2.4	2,411	9.9
8. Central	14,182	41.8	6,661	19.6	5,379	15.8	1,521	4.5	1,065	3.1	766	2.3	3,201	9.4
9. Central East	14,224	39.6	8,100	22.5	5,854	16.3	1,972	5.5	932	2.6	752	2.1	4,032	11.2
10. South East	6,263	38.7	4,421	27.3	2,580	16.0	829	5.1	357	2.2	357	2.2	1,824	11.3
11. Champlain	11,842	40.2	6,963	23.6	4,547	15.4	1,743	5.9	1,029	3.5	614	2.1	3,233	11.0
12. North Simcoe	4,822	39.3	2,889	23.6	1,826	14.9	808	6.6	387	3.2	270	2.2	1,322	10.8
13. North East	6,130	35.9	4,385	25.7	2,398	14.0	1,319	7.7	418	2.4	336	2.0	1,789	10.5
14. North West	2,365	35.1	2005	29.8	1,044	15.5	406	6.0	173	2.6	119	1.8	723	10.7

Note. LHIN = Local Health Integration Network. Percent of each injury is calculated with number per injury type per LHIN as the numerator and total count of FRIs per LHIN as the denominator. Waterloo = Waterloo Wellington, Hamilton = Hamilton Niagara Haldimand Brant, North Simcoe = North Simcoe Muskoka. TBI = traumatic brain injury. Sprain = sprains, strains, and tears of joint cartilage.

Table I2

Patients with Injuries by Body Location at the Emergency Department by Age Groups in years (2010-2014)

Body location	65+ years		65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Head	86,538	878	15,660	510	13,525	589	15,395	850	17,838	1,293	14,830	1,734	9,290	2,082
	(28.4)		(23.1)		(26.0)		(28.8)		(31.8)		(32.1)		(31.8)	
Neck	3,646	37	838	27	646	28	640	35	671	49	527	62	324	73
	(1.2)		(1.2)		(1.2)		(1.2)		(1.2)		(1.1)		(1.1)	
Trunk	47,765	484	10,133	330	8,029	350	8,444	466	8,995	652	7,514	878	4,650	1,042
	(15.7)		(14.9)		(15.5)		(15.8)		(16.1)		(16.3)		(15.9)	
Thorax	26,704	271	6,343	206	4,933	215	4,857	268	4,844	351	3,632	425	2,095	469
	(8.8)		(9.4)		(9.5)		(9.1)		(8.6)		(7,9)		(7.2)	
Abdomen	20,255	205	3,593	117	2,941	128	3,442	190	4,018	291	3,769	441	2,492	558
	(6.6)		(5.3)		(5.7)		(6.4)		(7.2)		(8.2)		(8.5)	
Upper limb	91,951	933	23,727	772	17,286	753	16,764	925	15,655	1,135	11,836	1,384	6,683	1,498
	(30.2)		(35.0)		(33.3)		(31.4)		(28.0)		(25.6)		(22.9)	
Shoulder, upper arm	33,961	344	8,183	266	6,311	275	6,459	357	5,962	432	4,479	524	2,567	575
	(11.1)		(12.1)		(12.1)		(12.1)		(10.6)		(9.7)		(8.8)	
Elbow and forearm	33,885	344	8,943	291	6,274	273	5,898	326	5,657	410	4,479	524	2,634	590
	(11.1)		(13.2)		(12.1)		(11.0)		(10.1)		(9.7)		(9.0)	
Wrist and hand	26,175	265	7,112	231	5,064	221	4,761	263	4,430	321	3,187	373	1,621	363
	(8.6)		(10.5)		(9.7)		(8.9)		(7.9)		(6.9)		(5.5)	
Lower limb	94,367	957	21,180	689	15,524	676	15,710	867	16,800	1,218	14,778	1,728	10,375	2,325
	(31.0)		(31.2)		(29.9)		(29.4)		(30.0)		(32.0)		(35.5)	
Hip and thigh	41,922	425	4,677	152	4,684	204	6,556	362	9,178	665	9,375	1,096	7,452	1,670
	(13.8)		(6.9)		(9.0)		(12.3)		(16.4)		(20.3)		(25.5)	
Knee and lower leg	36,555	371	10,611	345	7,402	323	6,499	359	5,628	408	4,139	484	2,276	510
	(12.0)		(15.6)		(14.2)		(12.2)		(10.0)		(9.0)		(7.8)	
Ankle and foot	16,667	169	6,238	203	3,633	158	2,752	152	2,080	151	1,300	152	664	149
	(5.5)		(9.2)		(7.0)		(5.2)		(3.7)		(2.8)		(2.3)	
Multiple body regions	5,407	55	1,020	33	832	36	981	54	1,080	78	915	107	579	130
	(1.8)		(1.5)		(1.6)		(1.8)		(1.9)		(2.0)		(2.0)	
Unspecified region	3,069	31	529	17	429	19	509	28	614	44	587	130	401	90
	(1.0)		(0.8)		(0.8)		(1.0)		(1.1)		(1.3)		(1.4)	

Note. Abdomen = abdomen, lower back, lumbar spine, and pelvis. Percent calculated with the total number of all FRIs at the ED per age group as the denominator.

Table I3

Types and Body Locations of Fractures in Female Patients at the Emergency Department, by Age Group (2010-2014)

Body location	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
All fractures	18,473	1,157	14,076	1,150	14,476	1,458	15,599	1,951	13,679	2,499	9,548	2,963
Skull, face	530	33	460	38	586	59	656	82	484	88	286	89
Vertebrae	436	27	462	38	618	62	750	94	687	126	465	144
Clavicle	267	17	216	18	230	23	250	31	209	38	159	49
Rib	815	51	672	55	760	77	925	116	811	148	564	175
Scapula	74	5	70	6	75	8	66	8	57	10	31	10
Humerus	2,285	143	1,809	148	1,919	193	1,902	238	1,529	279	857	266
Forearm	5,721	358	3,952	323	3,434	346	3,174	397	2,236	409	1,215	377
Hand, wrist	1,859	116	1,304	107	1,134	114	1,026	128	717	131	378	117
Pelvis	312	20	297	24	527	53	876	110	939	172	764	237
Hip	1,366	86	1,575	129	2,627	265	4,178	522	4,676	854	4,031	1,251
Femur	319	20	276	23	387	39	391	49	417	76	281	87
Knee, lower leg	1,763	110	1,199	98	1,021	103	753	94	526	96	285	88
Ankle	1,630	102	1,117	91	813	82	595	74	373	68	212	66
Foot	1,630	102	1,019	83	764	77	548	69	372	68	176	55

Note. Age-specific rates are calculated with total number of female observations per fracture type and age group as the numerator, and the sum of Ontario's female population over the five years per age group as the denominator; reported per 100,000 population.

Table I4

Types and Body Locations of Fractures in Male Patients at the Emergency Department, by Age Group (2010-2014)

Body location	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
All fractures	8,553	580	6,528	609	6,484	792	6,521	1,124	4,949	1,607	2,801	2,258
Skull, face	442	30	366	34	385	47	425	73	261	85	122	98
Vertebrae	422	29	347	32	401	49	422	73	394	128	186	150
Clavicle	251	17	155	14	163	20	152	26	107	35	64	52
Rib	1,653	112	1,273	119	1,164	142	1,025	177	667	217	339	273
Scapula	94	6	70	7	59	7	56	10	38	12	12	10
Humerus	672	46	507	47	571	70	575	99	405	131	205	165
Forearm	1,429	97	988	92	819	100	610	105	412	134	190	153
Hand, wrist	858	58	628	59	579	71	493	85	329	107	115	93
Pelvis	169	11	148	14	194	24	236	41	202	66	142	114
Hip	817	55	907	85	1,268	155	1,877	324	1,796	583	1,251	1,008
Femur	112	8	100	9	106	13	137	24	82	27	76	61
Knee, lower leg	768	52	541	51	424	52	315	54	157	51	70	56
Ankle	667	45	399	37	320	39	221	38	114	37	46	37
Foot	549	37	312	29	247	30	154	27	83	27	26	21

Note. Age-specific rates are calculated with total number of male observations per fracture type and age group as the numerator, and the sum of Ontario's male population over the five years per age group as the denominator; reported per 100,000 population.

Table I5

Types and Body Locations of Fractures in All Patients at the Emergency Department, by Age Group (2010-2014)

Body location	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
All fractures	27,026	880	20,604	898	20,960	1,157	22,120	1,603	18,628	2,178	12,349	2,767
Skull, face	972	32	826	36	971	54	1,081	78	745	87	408	91
Vertebrae	858	28	809	35	1,019	56	1,172	85	1,081	126	651	146
Clavicle	518	17	371	16	393	22	402	29	316	37	223	50
Rib	2,468	80	1,945	85	1,924	106	1,950	141	1,478	173	903	202
Scapula	168	5	140	6	134	7	122	9	95	11	43	10
Humerus	2,957	96	2,316	101	2,490	137	2,477	180	1,934	226	1,062	238
Forearm	7,150	233	4,940	215	4,253	235	3,784	274	2,648	310	1,405	315
Hand, wrist	2,717	88	1,932	84	1,713	95	1,519	110	1,046	122	493	110
Pelvis	481	16	445	19	721	40	1,112	81	1,141	133	906	203
Hip	2,183	71	2,482	108	3,895	215	6,055	439	6,472	757	5,282	1,184
Femur	431	14	376	16	493	27	528	38	499	58	357	80
Knee, lower leg	2,531	82	1,740	76	1,445	80	1,068	77	683	80	355	80
Ankle	2,297	75	1,516	66	1,133	63	816	59	487	57	258	58
Foot	2,179	71	1,331	58	1,011	56	702	51	455	53	202	45

Note. Age-specific rates are calculated with total number of observations per fracture type and age group as the numerator, and the sum of Ontario's population over the five years per age group as the denominator; reported per 100,000 population.

Table I6

Patients with Sprains, Strains, and Tears by Body Location, Age Group, and Sex at the Emergency Department (2010-2014)

Body location by sex	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Female	3,677	230	2,135	174	1,700	171	1,348	169	842	154	456	142
Neck	172	11	109	9	80	8	92	12	46	8	28	9
Trunk	230	14	183	15	170	17	150	19	115	21	59	18
Shoulder	289	18	189	15	190	19	147	18	100	18	57	18
Elbow, forearm	30	2	15	1	21	2	12	2	9	2	≤5	N/A
Wrist, hand	711	45	384	31	319	32	221	28	131	24	51	16
Hip	84	5	82	7	82	8	110	14	79	14	51	16
Knee, lower leg	691	43	378	31	279	28	183	23	131	24	68	21
Ankle, foot	1,563	98	850	69	598	60	467	58	249	45	150	47
Male	2,017	137	1,278	119	1,018	124	810	140	471	153	177	143
Neck	131	9	85	8	57	7	77	13	48	16	20	16
Trunk	201	14	142	13	115	14	115	20	61	20	26	21
Shoulder	271	18	225	21	184	22	127	22	79	26	27	22
Elbow, forearm	25	2	18	2	16	2	7	1	9	3	≤5	N/A
Wrist, hand	347	24	216	20	184	22	137	24	75	24	21	17
Hip	49	3	46	4	43	5	58	10	37	12	21	17
Knee, lower leg	428	29	240	22	195	24	138	24	89	29	30	24
Ankle, foot	596	40	332	31	244	30	170	29	82	27	34	27

Note. Age-specific rates are calculated with total number of observations per fracture type, age, and sex as the numerator, and the sum of Ontario's population over the five years per sex and age group as the denominator; reported per 100,000 population. Trunk = thorax, lumbar spine and pelvis. Shoulder = shoulder and upper arm. Knee = knee and lower leg.

Table I7
Fall-Related Injuries among Patients at the Emergency Department by Demographic Characteristics and Year

Characteristic	2010		2011		2012		2013		2014	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Total [a]	58,771	3,207	59,194	3,134	59,384	3,016	62,514	3,051	64,747	3,053
Age group [b]										
65-69	11,290	2,071	12,236	2,146	13,209	2,144	14,853	2,268	16,249	2,368
70-74	9,952	2,316	10,027	2,270	9,714	2,132	10,873	2,290	11,392	2,309
75-79	10,924	3,092	10,725	3,013	10,445	2,904	10,574	2,885	10,716	2,849
80-84	11,515	4,333	11,286	4,153	11,105	4,008	11,068	3,939	11,034	3,882
85-89	9,510	5,845	9,302	5,595	9,127	5,330	9,120	5,182	9,126	5,093
90+	5,580	7,342	5,618	6,773	5,784	6,447	6,026	6,302	6,230	6,110

Note. [a] Crude rates were calculated with number of observations per year as the numerator, and Ontario's population of older adults per year as the denominator. [b] Age-specific rates were calculated with the number of observations per year and age group as the numerator and Ontario's population of older adults per year and age group as the denominator. All rates were reported per 100,000 population.

Table I8
Fall-Related Injuries among Females at the Emergency Department by Demographic Characteristics and Year

Characteristic	2010		2011		2012		2013		2014	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Total [a]	38,130	3,714	37,791	3,582	37,497	3,424	38,652	3,406	39,974	3,412
Age group [b]										
65-69	6,956	2,449	7,478	2,521	7,985	2,496	8,864	2,607	9,805	2,749
70-74	6,204	2,699	6,199	2,626	5,946	2,445	6,434	2,544	6,758	2,580
75-79	6,855	3,522	6,558	3,354	6,436	3,266	6,415	3,206	6,484	3,160
80-84	7,426	4,744	7,138	4,501	6,958	4,337	6,757	4,181	6,761	4,160
85-89	6,547	6,168	6,312	5,848	6,071	5,528	5,938	5,332	5,789	5,165
90+	4,142	7,465	4,106	6,832	4,101	6,344	4,244	6,166	4,377	5,984

Note. [a] Crude rates were calculated with number of observations per year as the numerator, and Ontario's population of females per year as the denominator. [b] Age-specific rates were calculated with the number of observations per year and age group as the numerator and Ontario's population of females per year and age group as the denominator. All rates were reported per 100,000 population.

Table I9

Fall-Related Injuries among Males at the Emergency Department by Demographic Characteristics and Year

Age	2010		2011		2012		2013		2014	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
65+ [a]	20,641	2,561	21,403	2,567	21,887	2,504	23,862	2,611	24,773	2,609
Age group [b]										
65-69	4,334	1,660	4,758	1,739	5,224	1,764	5,989	1,903	6,444	1,956
70-74	3,748	1,875	3,828	1,862	3,768	1,774	4,439	2,001	4,634	2,002
75-79	4,069	2,564	4,167	2,599	4,009	2,465	4,159	2,499	4,232	2,476
80-84	4,089	3,743	4,148	3,665	4,147	3,556	4,311	3,612	4,273	3,511
85-89	2,963	5,240	2,990	5,125	3,056	4,976	3,182	4,924	3,337	4,973
90+	1,438	7,011	1,512	6,619	1,683	6,711	1,782	6,650	1,853	6,428

Note. [a] Crude rates were calculated with number of observations per year as the numerator, and Ontario's population of males per year as the denominator. [b] Age-specific rates were calculated with the number of observations per year and age group as the numerator and Ontario's population of males per year and age group as the denominator. All rates were reported per 100,000 population.

Table I10

Fractures Among Patients at the Emergency Department by Sex, Age Group, and Year

Age group (years)	2010		2011		2012		2013		2014	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Females	16,984	1,654	16,852	1,597	16,644	1,520	17,459	1,538	17,912	1,529
65-69	3,090	1,088	3,352	1,130	3,572	1,117	4,043	1,189	4,416	1,238
70-74	2,731	1,188	2,732	1,157	2,659	1,093	2,879	1,138	3,075	1,174
75-79	3,011	1,547	2,905	1,486	2,814	1,428	2,858	1,428	2,888	1,407
80-84	3,295	2,105	3,185	2,008	3,021	1,883	3,042	1,882	3,056	1,880
85-89	2,957	2,786	2,816	2,609	2,688	2,447	2,683	2,409	2,535	2,262
90+	1,900	3,424	1,862	3,098	1,890	2,924	1,954	2,839	1,942	2,655
Males	6,679	829	6,749	809	6,981	799	7,652	837	7,775	819
65-69	1,422	545	1,463	535	1,671	564	1,934	614	2,063	626
70-74	1,236	618	1,242	604	1,192	561	1,459	658	1,399	605
75-79	1,262	795	1,306	814	1,284	789	1,284	772	1,348	789
80-84	1,302	1,192	1,292	1,142	1,256	1,077	1,381	1,157	1,290	1,060
85-89	953	1,685	961	1,647	998	1,625	987	1,527	1,050	1,565
90+	504	2,457	485	2,123	580	2,313	607	2,265	625	2,168

Note. Age-specific rates calculated with the Ontario population per year and sex as the denominator; reported per 100,000 population.

Table I11

Body Locations of Fractures in Female Patients at the Emergency Department Admissions per Year

Body location	2010		2011		2012		2013		2014	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Forearm	3,849	375	3,871	367	3,787	346	4,043	356	4,182	357
Hip	3,835	374	3,724	353	3,676	336	3,650	322	3,568	305
Humerus	2,038	198	1,972	187	1,980	181	2,081	183	2,230	190
Wrist, hand	1,259	123	1,285	122	1,200	110	1,323	117	1,351	115
Knee, lower leg	1,062	103	1,090	103	1,035	95	1,164	103	1,196	102
Ankle	894	87	946	90	866	79	1,009	89	1,025	87
Foot	838	82	852	81	894	82	920	81	1,005	86
Rib	894	87	891	84	902	82	914	81	946	81
Pelvis	723	70	703	67	750	68	768	68	771	66
Vertebrae	668	65	633	60	652	60	724	64	741	63
Skull, facial	578	56	551	52	620	57	588	52	665	57
Femur	428	42	405	38	376	34	462	41	400	34
Clavicle	239	23	264	25	282	26	258	23	288	25
Scapula	73	7	68	6	88	8	70	6	74	6

Note. Sex-specific rates calculated with the Ontario female population of females per year as the denominator. Rates were reported per 100,000 population.

Table I12

Body Locations of Fractures in Male Patients at the Emergency Department Admissions per Year

Body location	2010		2011		2012		2013		2014	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Hip	1,556	193	1,544	185	1,584	181	1,580	173	1,652	174
Rib	1,106	137	1,118	134	1,193	136	1,352	148	1,352	142
Forearm	837	104	791	95	869	99	965	106	986	104
Wrist, hand	554	69	570	68	567	65	635	69	676	71
Humerus	533	66	574	69	587	67	621	68	620	65
Knee, lower leg	409	51	446	53	417	48	529	58	474	50
Vertebrae	393	49	374	45	433	50	483	53	489	52
Skull, Facial	350	56	405	49	397	45	407	45	442	47
Ankle	314	39	303	36	338	39	411	45	401	42
Foot	260	32	271	32	239	27	297	33	304	32
Pelvis	201	25	204	24	214	24	228	25	244	26
Clavicle	160	20	169	20	182	21	180	20	201	21
Femur	117	15	128	15	116	13	124	14	128	13
Scapula	60	7	69	8	67	8	61	7	72	8

Note. Sex-specific rates calculated with the Ontario male population of males per year as the denominator. Rates were reported per 100,000 population.

Table I13

Traumatic Brain Injuries Among Patients at the Emergency Department by Sex, Age Group, and Year

Age group	2010		2011		2012		2013		2014	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Females [c]	709	69	753	71	763	70	907	80	1,100	94
65-69 [b]	119	42	123	41	147	46	206	61	252	71
70-74	111	48	131	55	114	47	160	63	184	70
75-79	115	59	115	59	124	63	125	62	194	95
80-84	145	93	166	105	165	103	185	114	195	120
85-89	154	145	132	122	141	128	146	131	162	145
90+	65	117	86	143	72	111	85	123	113	155
Males [c]	665	83	808	97	866	99	920	101	1,104	116
65-69 [b]	122	47	153	56	150	51	190	60	235	71
70-74	126	63	138	67	158	74	166	75	193	83
75-79	140	88	155	97	188	116	169	102	200	117
80-84	139	127	189	167	178	153	198	166	221	182
85-89	91	161	109	187	135	220	124	192	173	258
90+	47	229	64	280	57	227	73	272	82	284

Note. [a] Crude rates were calculated with total number of observations as the numerator and the sum of Ontario's population over the five years as the denominator. [b] Age-specific rates were calculated with total number of observations per age group as the numerator, and the sum of Ontario's population over the five years per age group as the denominator. [c] Sex-specific rates were calculated with total number of observations per sex as the numerator and the sum of Ontario's population over the five years per sex as the denominator. Rates were reported per 100,000.

Table I14

Open Wounds Among Patients at the Emergency Department by Sex, Age Group, and Year

Age group	2010		2011		2012		2013		2014	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Total [a]	9,681	528	9,756	517	9,701	493	9,930	485	10,080	475
65-69 [b]	1,470	270	1,580	277	1,702	276	1,807	276	1,881	274
70-74	1,367	318	1,469	333	1,388	305	1,519	320	1,595	323
75-79	1,790	507	1,757	494	1,664	463	1,692	462	1,683	447
80-84	2,166	815	2,007	738	2,015	727	1,971	702	1,963	691
85-89	1,762	1,083	1,767	1,063	1,789	1,045	1,712	973	1,749	976
90+	1,126	1,482	1,176	1,418	1,143	1,274	1,229	1,285	1,209	1,186
Females [c]	5,281	514	5,234	496	5,164	472	5,142	453	5,247	448
65-69 [b]	703	247	722	243	801	250	815	240	914	256
70-74	690	300	723	306	709	292	770	304	751	287
75-79	914	470	918	469	851	432	847	423	840	409
80-84	1,163	743	1,078	680	1,027	640	988	611	1,029	633
85-89	1,050	989	1,042	965	1,047	953	959	861	960	857
90+	761	1,371	751	1,250	729	1,128	763	1,109	753	1,030
Males [c]	4,400	546	4,522	542	4,537	519	4,788	524	4,833	509
65-69 [b]	767	294	858	314	901	304	992	315	967	294
70-74	677	339	746	363	679	320	749	338	844	365
75-79	876	552	839	523	813	500	845	508	843	493
80-84	1,003	918	929	821	988	847	983	824	934	767
85-89	712	1,259	725	1,243	742	1,208	753	1,165	789	1,176
90+	365	1,780	425	1,861	414	1,651	466	1,739	456	1,582

Note. [a] Crude rates were calculated with total number of observations as the numerator and the sum of Ontario's population over the five years as the denominator. [b] Age-specific rates were calculated with total number of observations per age group as the numerator, and the sum of Ontario's population over the five years per age group as the denominator. [c] Sex-specific rates were calculated with total number of observations per sex as the numerator and the sum of Ontario's population over the five years per sex as the denominator. Rates were reported per 100,000.

Table I15

Superficial Injuries Among Patients at the Emergency Department by Sex, Age Group, and Year

Age group	2010		2011		2012		2013		2014	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Total [a]										
65-69 [b]	2,639	484	2,814	493	3,081	500	3,343	510	3,712	541
70-74	2,375	553	2,314	524	2,287	502	2,578	543	2,632	534
75-79	2,645	749	2,553	717	2,508	697	2,494	680	2,427	645
80-84	2,676	1,007	2,671	983	2,686	970	2,640	940	2,586	910
85-89	2,237	1,375	2,131	1,282	2,089	1,220	2,087	1,186	2,158	1,204
90+	1,224	1,611	1,227	1,479	1,277	1,423	1,314	1,374	1,482	1,453
Females [c]										
65-69 [b]	1,572	553	1,645	555	1,798	562	1,937	570	2,131	597
70-74	1,462	636	1,402	594	1,343	552	1,411	558	1,474	563
75-79	1,605	825	1,473	753	1,509	766	1,439	719	1,417	691
80-84	1,693	1,081	1,601	1,009	1,630	1,016	1,541	954	1,522	936
85-89	1,509	1,422	1,395	1,293	1,369	1,247	1,321	1,186	1,324	1,181
90+	907	1,635	881	1,466	878	1,358	880	1,279	1,024	1,400
Males [c]										
65-69 [b]	1,067	409	1,169	427	1,283	433	1,406	447	1,581	480
70-74	913	457	912	444	944	445	1,167	526	1,158	500
75-79	1,040	655	1,080	673	999	614	1,055	634	1,010	591
80-84	983	900	1,070	945	1,056	905	1,099	921	1,064	874
85-89	728	1,287	736	1,262	720	1,172	766	1,185	834	1,243
90+	317	1,546	346	1,515	399	1,591	434	1,619	458	1,589

Note. [a] Crude rates were calculated with total number of observations as the numerator and the sum of Ontario's population over the five years as the denominator. [b] Age-specific rates were calculated with total number of observations per age group as the numerator, and the sum of Ontario's population over the five years per age group as the denominator. [c] Sex-specific rates were calculated with total number of observations per sex as the numerator and the sum of Ontario's population over the five years per sex as the denominator. Rates were reported per 100,000.

Table I16

Sprains, Strains, and Tears Among Patients at the Emergency Department by Sex, Age Group, and Year

Age group	2010		2011		2012		2013		2014	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
All patients [a]	3,114	170	3,091	164	3,046	155	3,309	162	3,369	159
65-69 [b]	958	176	1,038	182	1,064	173	1,250	191	1,384	202
70-74	695	162	647	146	625	137	749	158	697	141
75-79	583	165	543	153	540	150	524	143	528	140
80-84	468	176	458	169	436	157	382	136	414	146
85-89	285	175	284	171	249	145	269	153	226	126
90+	125	164	121	146	132	147	135	141	120	118
Females [c]	2,101	205	2,025	192	1,926	176	2,045	180	2,061	176
65-69 [b]	660	232	676	228	694	217	765	225	882	247
70-74	465	202	419	177	369	152	480	190	402	153
75-79	392	201	356	182	338	172	292	146	322	157
80-84	308	197	289	182	271	169	243	150	237	146
85-89	181	171	195	181	160	146	167	150	139	124
90+	95	171	90	150	94	145	98	142	79	108
Males [c]	1,013	126	1,066	128	1,120	128	1,264	138	1,308	138
65-69 [b]	298	114	362	132	370	125	485	154	502	152
70-74	230	115	228	111	256	121	269	121	295	127
75-79	191	120	187	117	202	124	232	139	206	121
80-84	160	146	169	149	165	141	139	116	177	145
85-89	104	184	89	153	89	145	102	158	87	130
90+	30	146	31	136	38	152	37	138	41	142

Note. [a] Crude rates were calculated with total number of observations as the numerator and the sum of Ontario's population over the five years as the denominator. [b] Age-specific rates were calculated with total number of observations per age group as the numerator, and the sum of Ontario's population over the five years per age group as the denominator. [c] Sex-specific rates were calculated with total number of observations per sex as the numerator and the sum of Ontario's population over the five years per sex as the denominator. Rates were reported per 100,000.

Appendix H. Hospital Results for Fall-Related Injuries

Table J1
Types and Body Locations in Female Patients at the Hospital by Age Group (2010-2014)

Injury type and body location	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
All FRIs	12,030	753	11,210	916	14,276	1,438	18,210	2,277	18,165	3,319	13,722	4,259
Fracture	6,730	421	6,022	492	7,708	777	9,894	1,237	9,843	1,798	7,592	2,356
Skull/facial	171	11	164	13	250	25	301	38	243	44	161	50
Vertebral	222	14	259	21	373	38	498	62	473	86	347	108
Rib	273	17	235	19	326	33	475	59	482	88	377	117
Pelvis	190	12	222	18	388	39	695	87	795	145	635	197
Clavicle	90	6	71	6	94	9	124	16	114	21	80	25
Humerus	870	54	760	62	938	95	1,019	127	880	161	585	182
Forearm	1,283	80	1,032	84	1,129	114	1,262	158	1,013	185	652	202
Wrist/hand	369	23	274	22	297	30	355	44	324	59	192	60
Hip	1,345	84	1,554	127	2,590	261	4,128	516	4,617	844	3,977	1,234
Femur	306	4	263	4	372	7	380	10	403	15	269	17
Knee/lower leg	767	48	525	43	520	52	439	55	341	62	201	62
Ankle	796	50	612	50	470	47	397	50	269	49	156	48
Foot	296	4	232	4	205	4	195	5	167	6	95	6
Superficial	2,111	132	2,023	165	2,684	270	3,382	423	3,388	619	2,438	757
Open wound	1,018	64	1,135	93	1,563	157	2,127	266	2,288	418	1,930	599
TBI	375	23	396	32	452	46	673	84	623	114	353	110
Sprain, strain, tear	605	38	454	37	468	47	459	57	347	63	222	69
Dislocation	280	18	230	19	272	27	247	31	199	36	115	36

Note. Age-specific rates are calculated with total number of female observations per characteristic as the numerator, and the sum of Ontario's female population over the five years per characteristic as the denominator. Rates reported per 100,000 population.

Table J2
Types and Body Locations in Male Patients at the Hospital by Age Group (2010-2014)

Injury type and body location	65-69 years		70-74 years		75-79 years		80-84 years		85-89 years		90+ years	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
All FRIs	9,404	638	8,462	790	10,112	1,235	11,969	2,063	9,897	3,213	5,753	4,237
Fracture	3,832	260	3,299	308	3,857	471	4,490	774	3,785	1,229	2,335	1,882
Skull/facial	248	17	205	19	220	27	255	44	158	51	87	70
Vertebral	259	18	239	22	299	37	323	56	300	97	148	119
Rib	585	40	523	49	580	71	563	97	424	138	233	188
Pelvis	127	9	117	11	158	19	195	34	169	34	125	101
Clavicle	104	7	67	6	78	10	86	15	62	20	46	37
Humerus	341	23	263	25	329	40	348	60	261	85	141	114
Forearm	444	30	331	31	308	38	274	47	221	72	117	94
Wrist/hand	186	12	158	13	186	19	202	25	158	29	58	18
Hip	799	54	888	83	1,249	152	1,856	320	1,779	578	1,238	998
Femur	104	1	93	2	99	2	132	5	81	5	73	12
Knee/lower leg	344	23	274	26	222	27	182	31	110	36	47	38
Ankle	338	23	208	19	190	23	131	23	76	25	39	31
Foot	151	2	77	1	85	2	51	2	39	3	11	2
Superficial	1,894	128	1,791	167	2,219	271	2,598	448	2,152	699	1,168	942
Open wound	1,489	101	1,342	125	1,819	222	2,452	423	2,027	658	1,278	1,030
TBI	500	34	542	51	700	85	780	134	560	182	285	230
Sprain, strain, tear	444	30	352	33	338	41	317	55	221	72	102	82
Dislocation	246	17	192	18	187	23	152	26	104	34	41	33

Note. Age-specific rates are calculated with total number of male observations per characteristic as the numerator, and the sum of Ontario's male population over the five years per characteristic as the denominator. Rates reported per 100,000 population.

Table J3
Patients with Fall-Related Injuries at the Hospital by Age and Year

Age group (years)	2010		2011		2012		2013		2014	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Total [a]	28,259	1,542	28,138	1,490	28,201	1,432	28,964	1,414	29,648	1,398
Age group [b]										
65-69	3,660	671	3,929	689	4,187	680	4,609	704	5,049	736
70-74	3,842	894	3,791	858	3,738	821	4,112	866	4,189	849
75-79	5,066	1,434	4,947	1,390	4,827	1,342	4,773	1,302	4,775	1,269
80-84	6,289	2,366	6,091	2,241	5,973	2,156	5,933	2,112	5,893	2,073
85-89	5,755	3,537	5,656	3,402	5,612	3,277	5,525	3,140	5,514	3,077
90+	3,647	4,799	3,724	4,490	3,864	4,307	4,012	4,195	4,228	4,146

Note. [a] Crude rates were calculated with number of observations per year as the numerator, and Ontario's population of older adults per year as the denominator. [b] Age-specific rates were calculated with the number of observations per year and age group as the numerator and Ontario's population of older adults per year and age group as the denominator. All rates were reported per 100,000 population.

Table J4

Female Patients with Fall-Related Injuries at the Hospital by Age and Year

Age group (years)	2010		2011		2012		2013		2014	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Total [a]	17,827	1,736	17,445	1,654	17,179	1,569	17,436	1,536	17,726	1,513
Age group [b]										
65-69	2,043	719	2,228	751	2,324	727	2,586	760	2,849	799
70-74	2,224	968	2,189	927	2,160	888	2,283	903	2,354	899
75-79	3,075	1,580	2,909	1,488	2,796	1,419	2,745	1,372	2,751	1,341
80-84	3,965	2,533	3,676	2,318	3,609	2,250	3,509	2,171	3,451	2,123
85-89	3,875	3,651	3,752	3,476	3,603	3,281	3,537	3,176	3,398	3,032
90+	2,645	4,767	2,691	4,478	2,687	4,157	2,776	4,033	2,923	3,996

Note. [a] Crude rates were calculated with number of observations per year as the numerator, and Ontario's population of older adults per year as the denominator. [b] Age-specific rates were calculated with the number of observations per year and age group as the numerator and Ontario's population of female older adults per year and age group as the denominator. All rates were reported per 100,000 population.

Table J5

Male Patients with Fall-Related Injuries at the Hospital by Age and Year

Age group (years)	2010		2011		2012		2013		2014	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Total [a]	10,432	1,294	10,693	1,282	11,022	1,261	11,528	1,262	11,922	1,256
Age group [b]										
65-69	1,617	619	1,701	622	1,863	629	2,023	643	2,200	668
70-74	1,618	809	1,602	779	1,578	743	1,829	825	1,835	793
75-79	1,991	1,255	2,038	1,271	2,031	1,249	2,028	1,219	2,024	1,184
80-84	2,324	2,128	2,415	2,134	2,364	2,027	2,424	2,031	2,442	2,007
85-89	1,880	3,325	1,904	3,264	2,009	3,271	1,988	3,076	2,116	3,154
90+	1,002	4,885	1,033	4,522	1,177	4,694	1,236	4,612	1,305	4,527

Note. [a] Crude rates were calculated with number of observations per year as the numerator, and Ontario's population of older adults per year as the denominator. [b] Age-specific rates were calculated with the number of observations per year and age group as the numerator and Ontario's population of male older adults per year and age group as the denominator. All rates were reported per 100,000 population.

Table J6
Patients with Various Injury Types and Locations at the Hospital by Year

Injury type and body location	2010		2011		2012		2013		2014	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Fracture	13,904	759	13,676	724	13,630	692	14,098	688	14,079	664
Skull/facial	472	26	465	25	469	24	496	24	565	27
Vertebral	703	38	668	35	747	38	795	39	827	39
Rib	974	53	957	51	994	50	1,092	53	1,059	50
Pelvis	742	40	703	37	777	39	774	38	820	39
Clavicle	194	11	208	11	213	11	198	10	203	10
Humerus	1,357	74	1,349	71	1,319	67	1,358	66	1,352	64
Forearm	1,651	90	1,573	83	1,589	81	1,613	79	1,640	77
Wrist/hand	580	32	551	29	499	25	564	28	565	27
Hip	5,310	290	5,195	275	5,191	264	5,163	252	5,161	243
Femur	515	28	519	27	474	24	563	27	504	24
Knee/lower leg	785	43	816	43	741	38	819	40	811	38
Ankle	709	39	723	38	714	36	782	38	754	36
Foot	285	16	325	17	329	17	340	17	325	15
Superficial	5,506	300	5,464	289	5,497	279	5,546	271	5,835	275
Open wound	4,060	222	3,960	210	4,060	206	4,189	204	4,199	198
TBI	999	55	1,189	63	1,203	61	1,304	64	1,549	73
Sprain, strain, tear	898	49	833	44	841	43	881	43	876	41
Dislocation	482	26	416	22	442	22	472	23	453	21

Note. Crude rates were calculated with number of observations per year as the numerator, and Ontario's population of older adults per year as the denominator. Rates reported per 100,000.

Curriculum Vitae

Name:	Nicolette A. Lappan
Post-Secondary Education and Degrees:	Western University London, Ontario, Canada 2012-2016 B.H.Sc with Distinction Western University London, Ontario, Canada 2018-2021 M.Sc
Honours and Awards:	Dean's Honour List Western University 2014-2015 2015-2016
Related Work Experience:	Teaching Assistant Western University Winter 2019 Term HS 3701 The Aging Body Teaching Assistant Western University Fall 2019 Term HS 1001 Personal Determinants of Health
Presentations and Submissions:	Lappan, N., Zecevic, A.A., Hunter, S., Johnson, A. (2020). Descriptive analysis of serious fall-related injuries among older adults in Ontario, Canada – Preliminary results. HRS Graduate Research Conference, London, ON, February 4, 2020. Oral Presentation. Lappan, N., Zecevic, A.A., Hunter, S., Johnson, A. (2020). Descriptive analysis of serious fall-related injuries among older adults in Ontario, Canada – Preliminary results. 5th National Fall Prevention Conference, Saskatoon, SK, June 15-16, 2020. Oral Presentation. Conference cancelled due to COVID-19

Presentations and Submissions:

Lappan, N., Zecevic, A., Ming, Y., Hunter, S., and Johnson, A. (2021) Descriptive Epidemiology of Fall-Related Injuries Among Older Adults in Ontario. Gerontological Society of America Annual Meeting, Nov 10-14, 2021, Phoenix, Arizona.

Lappan, N., Zecevic, A., Ming, Y., Hunter, S., and Johnson, A. (2021). How might ICD-10-CA codes affect fall-related injury prevention? Canadian Association on Gerontology, Oct 21-23, 2021, Toronto, Ontario.